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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :  H04R 1/02, 5/02, 7/06, 9/06, 17/00, 1/42, H04N 5/64, B65D 79/00, G06F 1/16, G10H 1/32, G03B 21/56, B42D 15/02, G07F 9/02, G09F 27/00		A3	(11) International Publication Number: WO 97/09842  (43) International Publication Date: 13 March 1997 (13.03.97)
<p>(21) International Application Number: PCT/GB96/02145</p> <p>(22) International Filing Date: 2 September 1996 (02.09.96)</p> <p>(30) Priority Data: 9517918.0 2 September 1995 (02.09.95) GB 9522281.6 31 October 1995 (31.10.95) GB 9606836.6 30 March 1996 (30.03.96) GB</p> <p>(71) Applicant (<i>for all designated States except US</i>): VERITY GROUP PLC [GB/GB]; Stonehill, Huntingdon, Cambridgeshire PE18 6ED (GB).</p> <p>(72) Inventors; and (75) Inventors/Applicants (<i>for US only</i>): AZIMA, Henry [CA/GB]; 3 Southacre Close, Chaucer Road, Cambridge CB2 2TT (GB). COLLOMS, Martin [GB/GB]; 22 Burgess Hill, London NW2 2DA (GB). HARRIS, Neil [GB/GB]; 9 Davey Crescent, Great Shelford, Cambridge CB2 5JF (GB).</p> <p>(74) Agent: MAGUIRE &amp; CO.; 5 Crown Street, St. Ives, Cambridgeshire PE17 4EB (GB).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> <p>(88) Date of publication of the international search report: 10 July 1997 (10.07.97)</p>	
<p>(54) Title: ACOUSTIC DEVICE</p> <p>(57) Abstract</p> <p>Acoustic device (81) including a member (2) extending transversely of its thickness and capable of sustaining bending waves at least over an intendedly consequentially acoustically active area of the transverse extent of said member, the member (2) having, by reason of orderly design methodology disclosed and claimed, a distribution of resonant modes of its natural bending wave vibration at least over said area that is dependent on values of particular parameters of said members, including geometrical configuration and directional bending stiffness(es), which values have been selected to predetermine said distribution of natural resonant modes being consonant with required achievable acoustic action of said member for operation of said device over a desired operative acoustic frequency range.</p>			

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# INTERNATIONAL SEARCH REPORT

Intern. Application No  
PCT/GB 96/02145

A. CLASSIFICATION OF SUBJECT MATTER				
IPC 6	H04R1/02	H04R5/02	H04R7/06	H04R9/06
	H04R1/42	H04N5/64	B65D79/00	G06F1/16
	G03B21/56	842D15/02	G07F9/02	G09F27/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 247 925 A (WARNAKA) 26 April 1966	1,2, 20-22, 52-54, 74,75
A	see column 2, line 55 - column 3, line 38; figures	3-19. 23-51, 55-72, 76-94
Y	---	73
Y	PATENT ABSTRACTS OF JAPAN vol. 007, no. 080 (E-168), 2 April 1983 & JP 58 008000 A (MURATA SEISAKUSHO:KK), 17 January 1983, see abstract	73
A	---	-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

### \* Special categories of cited documents :

- 'A' document defining the general state of the art which is not considered to be of particular relevance
- 'E' earlier document but published on or after the international filing date
- 'L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- 'O' document referring to an oral disclosure, use, exhibition or other means
- 'P' document published prior to the international filing date but later than the priority date claimed

'T' later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

'X' document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

'Y' document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents such combination being obvious to a person skilled in the art.

'&' document member of the same patent family

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Date of the actual completion of the international search

Date of mailing of the international search report

13 March 1997

29.05.97

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## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 96/02145

## C(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 010 637 A (SONY CORP) 27 June 1979 see page 2, line 77 - page 3, line 78; figures ---	1
A	US 3 347 335 A (WATTERS ET AL.) 17 October 1967 cited in the application see column 1, line 13 - column 2, line 37; figures ---	1-94
A	WO 92 03024 A (SECR DEFENCE BRIT) 20 February 1992 cited in the application see page 5, line 4 - page 6, line 5; figures ---	1-94
A	US 3 422 921 A (WARNAKA) 21 January 1969 see column 1, line 20 - column 3, line 18; figures ---	1-94
A	US 5 333 202 A (OKAYA ET AL.) 26 July 1994 see column 4, line 47 - column 6, line 22; figures ---	1-94
A	SOVIET PHYSICS TECHNICAL PHYSICS, vol. 37, no. 3, 1 March 1992, pages 347-350, XP000335744 DREIDEN G V ET AL: "INTERFERENCE-HOLOGRAPHIC STUDY OF OSCILLATIONS OF HONEYCOMB DIAPHRAGMS" see page 347, left-hand column, line 1 - page 348, left-hand column, line 9; figures -----	1

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/GB 96/02145

**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3.  Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

**see extra sheets**

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-94

**Remark on Protest** The additional search fees were accompanied by the applicant's protest. No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/210

- Group I: claims 1-94 are directed generally to a method of making of or to an acoustic device including a member capable of sustaining bending waves, or to different embodiments thereof.
- Group II: claim 95 is directed to a distributed mode acoustic radiator with a drive and a baffle.
- Group III: claim 96 is directed to a distributed mode acoustic radiator with a supporting frame.
- Group IV: claim 97 is directed to a distributed mode acoustic radiator with means for varying the air pressure .
- Group V: claim 98 is directed to a distributed mode acoustic radiator with an inertial vibration transducer comprising resilient means.
- Group VI: claim 104 is directed to a distributed mode acoustic radiator with two transducers.
- Group VII: claims 105-106 are directed to a distributed mode acoustic member with sound sensor or microphone.
- Group VIII: claim 107 is directed to a distributed mode acoustic radiator with suspended ceiling tile.
- Group IX: claim 108 is directed to a distributed mode acoustic radiator with visual display unit and transducer means mounted wholly and exclusively on the radiator.
- Group X: claim 109 is directed to a distributed mode acoustic radiator with lap-top computer and a transducer mounted wholly and exclusively on the radiator.
- Group XI: claim 110 is directed to a distributed mode acoustic radiator with a portable compact-disc player and a transducer mounted wholly and exclusively on the radiator.
- Group XII: claim 111 is directed to a distributed mode acoustic radiator within a vehicle and a transducer mounted wholly and exclusively on the radiator.
- Group XIII: claim 112 is directed to a distributed mode acoustic radiator with a vehicle component and a transducer mounted on the radiator.
- Group XIV: claim 113 is directed to a distributed mode acoustic radiator with an electronic musical instrument having a keyboard and a transducer mounted wholly and exclusively on the radiator.
- Group XV: claim 114 is directed to a distributed mode acoustic radiator with a vending machine and a transducer mounted wholly and exclusively on the radiator.
- Group XVI: claim 115 is directed to a distributed mode acoustic radiator with a notice board and a transducer mounted wholly and exclusively on the radiator.
- Group XVII: claim 116 is directed to a distributed mode acoustic radiator with a packaging and a transducer mounted wholly and exclusively on the radiator.

FURTHER INFORMATION CONTINUED FROM PCT/MSA/210

- Group XVIII: claim 117 is directed to a distributed mode acoustic radiator with a greetings card and a transducer mounted wholly and exclusively on the radiator.
- Group XIX: claims 118-121 are directed to a distributed mode acoustic radiator with a display screen card and a transducer mounted wholly and exclusively on the radiator.
- Group XX: claim 100 is directed to an inertial transducer with plate-like piezo-electric bender.
- Group XXI: claim 102 is directed to a transducer with a motor coil assembly and a magnet assembly comprising opposed disc-like pole pieces with a surrounding flange adapted to surround and to be disposed adjacent to the motor coil.

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International Application No

PCT/GB 96/02145

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 3247925 A	26-04-66	GB 1013643 A		
GB 2010637 A	27-06-79	AT 362000 B CA 1102444 A DE 2850786 A FR 2410410 A NL 7811631 A,B, US 4198550 A		10-04-81 02-06-81 18-10-79 22-06-79 29-05-79 15-04-80
US 3347335 A	17-10-67	NONE		
WO 9203024 A	20-02-92	GB 2246684 A AT 117155 T DE 69106712 D DE 69106712 T EP 0541646 A GB 2262861 A,B JP 5509211 T		05-02-92 15-01-95 23-02-95 08-06-95 19-05-93 30-06-93 16-12-93
US 3422921 A	21-01-69	DE 1658909 A GB 1185352 A		27-04-72 25-03-70
US 5333202 A	26-07-94	AU 3777289 A CA 1338084 A CN 1038387 A JP 3505511 T WO 8912373 A		05-01-90 27-02-96 27-12-89 28-11-91 14-12-89

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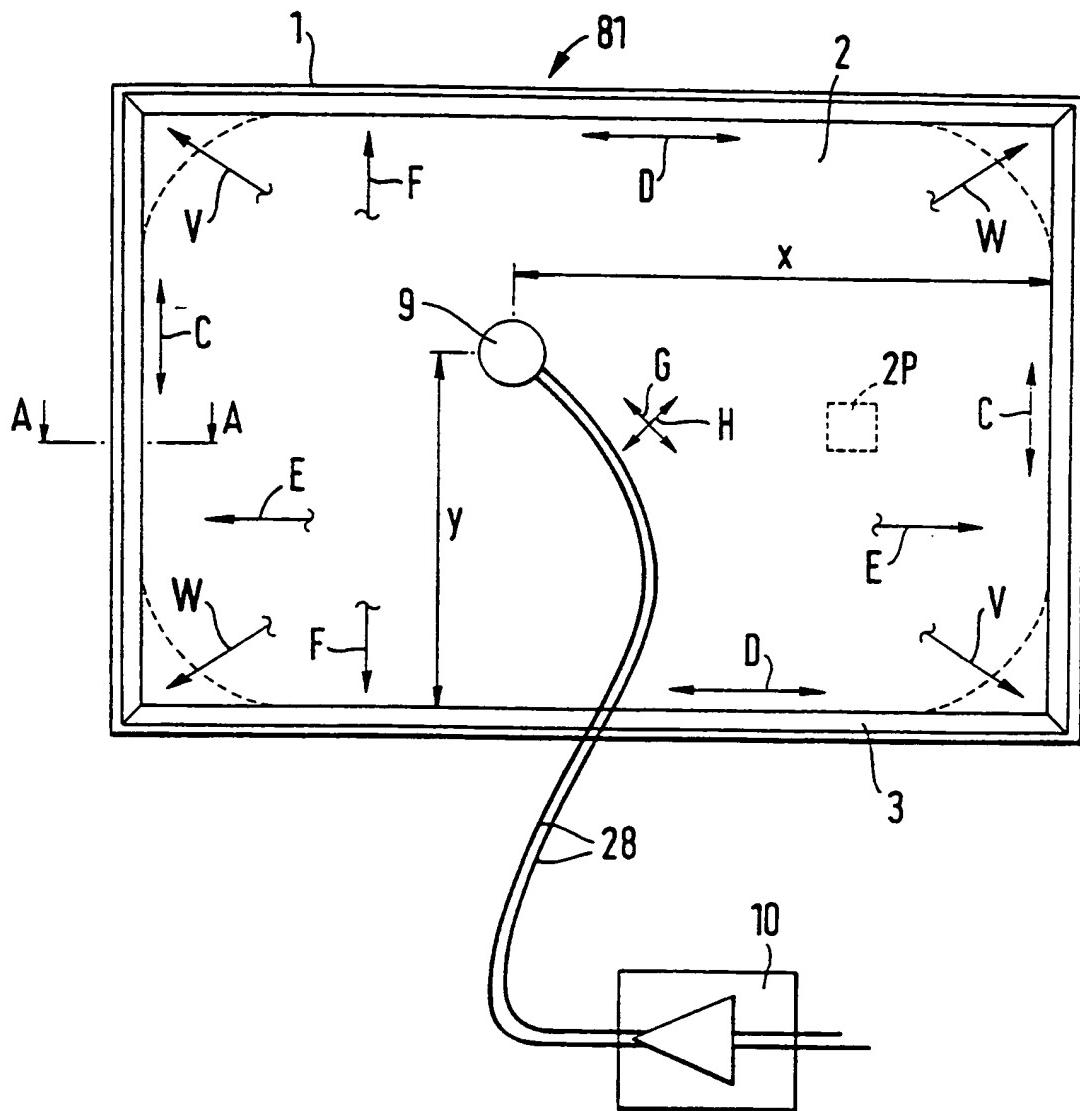


Fig. 1

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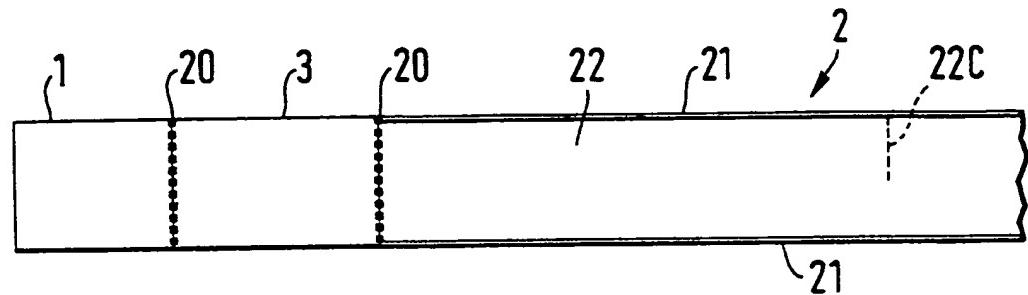


Fig. 2a

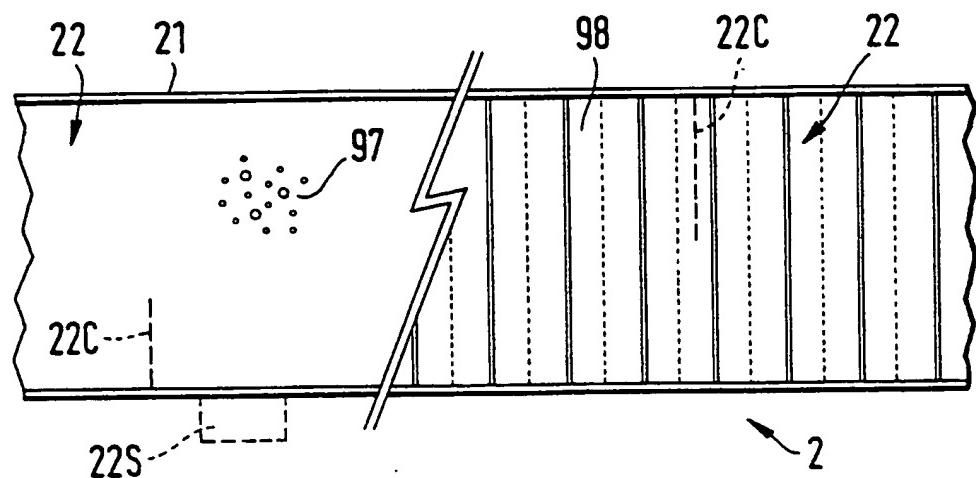


Fig. 2b

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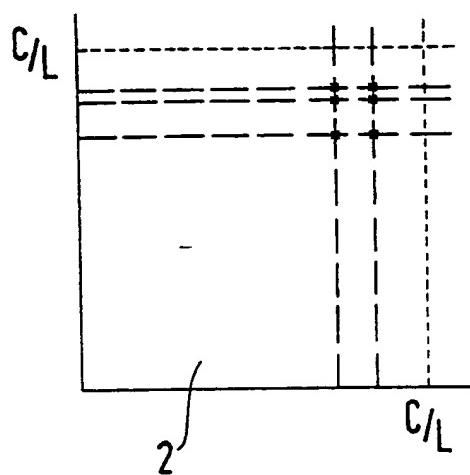


Fig. 3a

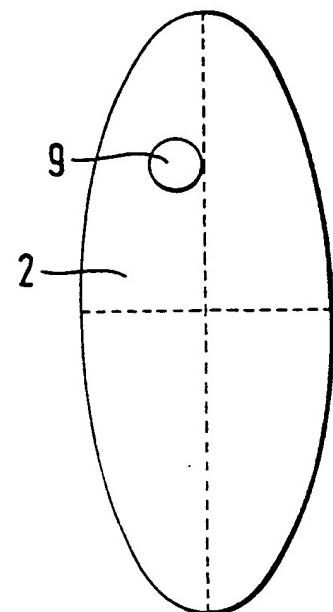


Fig. 3b

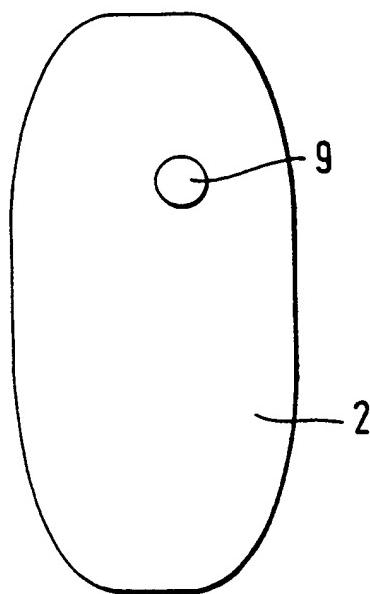


Fig. 3c

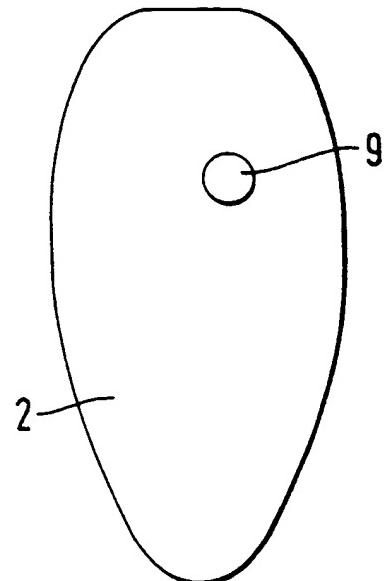


Fig. 3d

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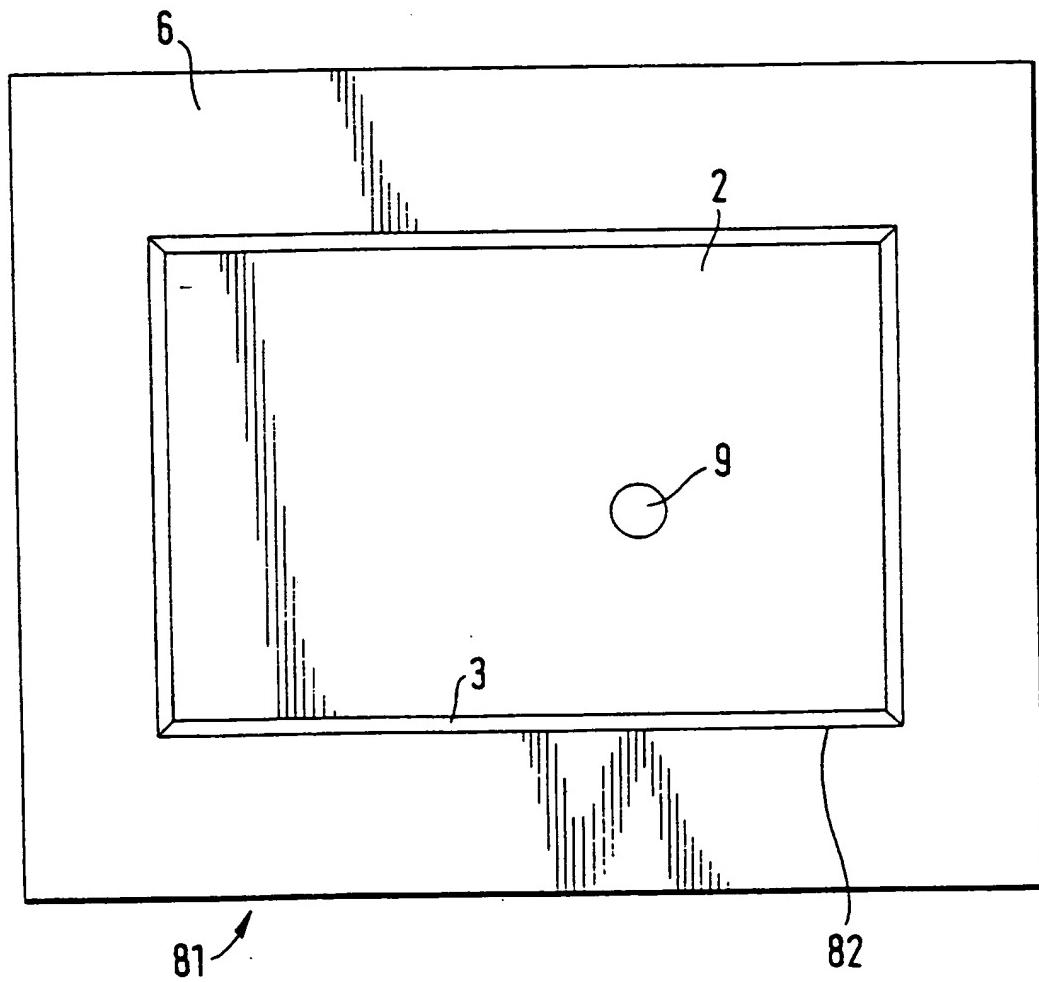


Fig. 4

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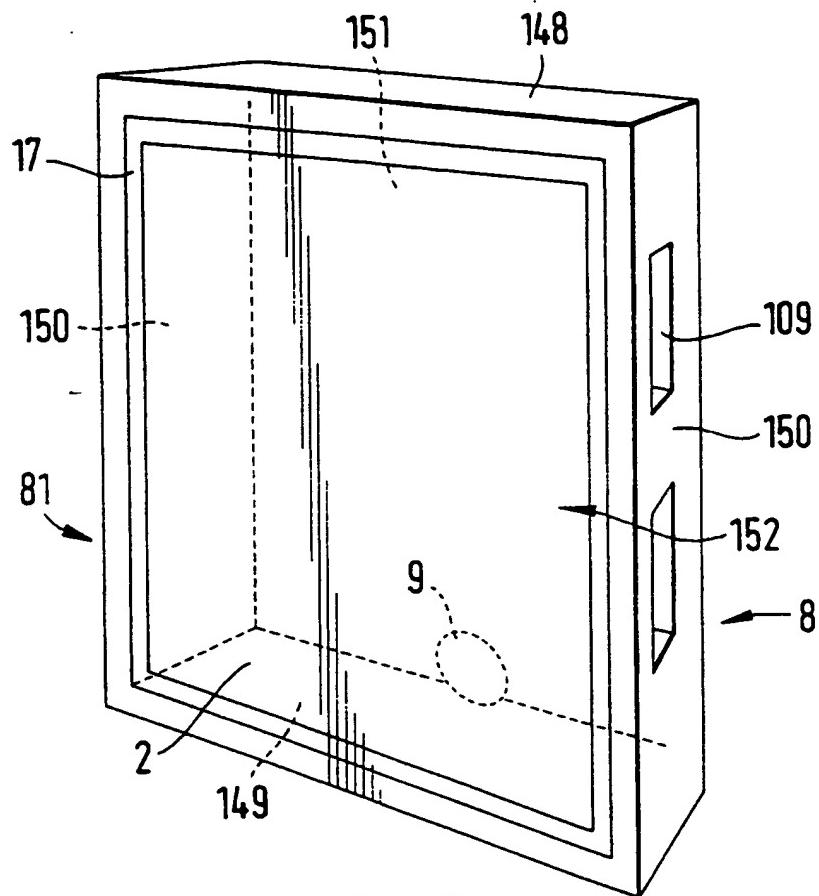


Fig. 5a

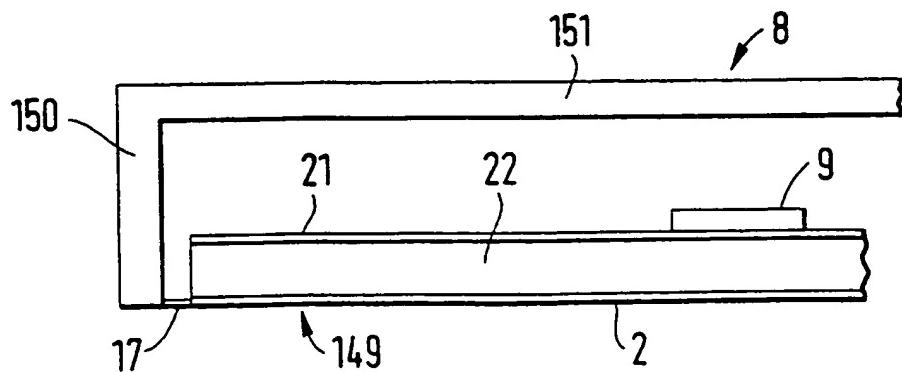


Fig. 5b

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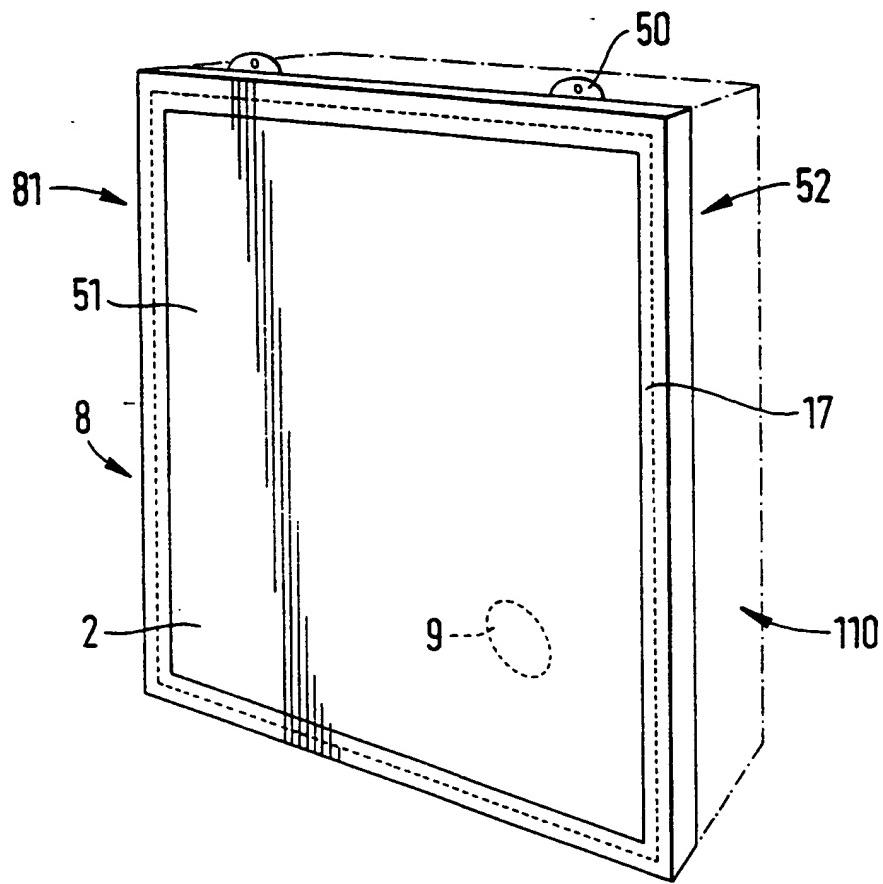


Fig.6a

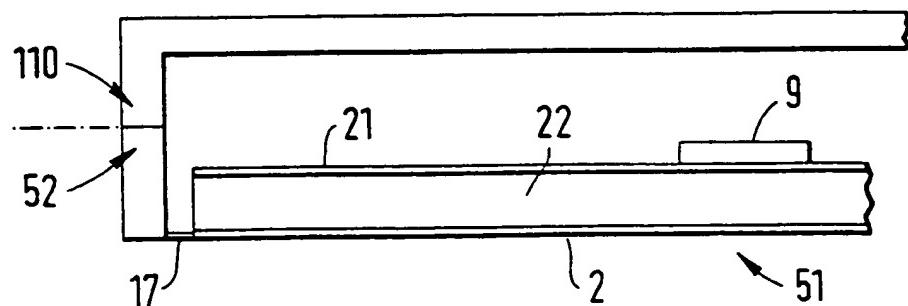


Fig.6b

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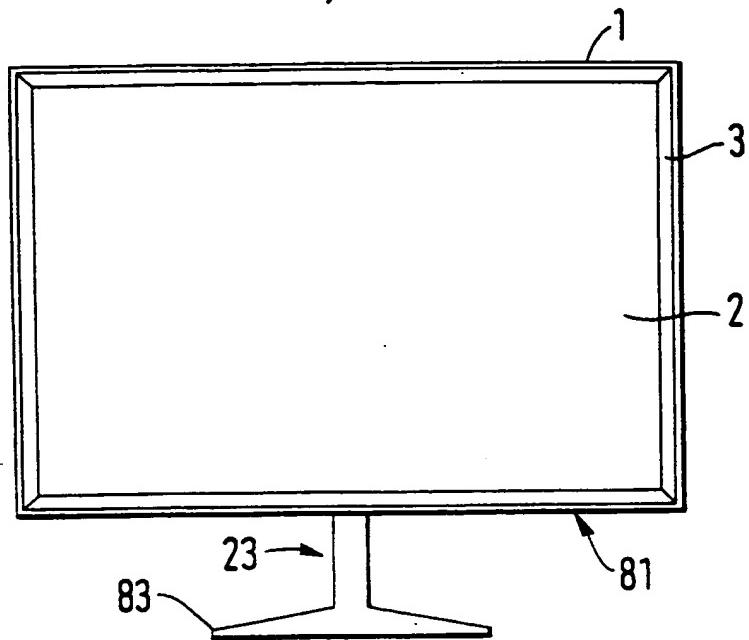


Fig. 7a

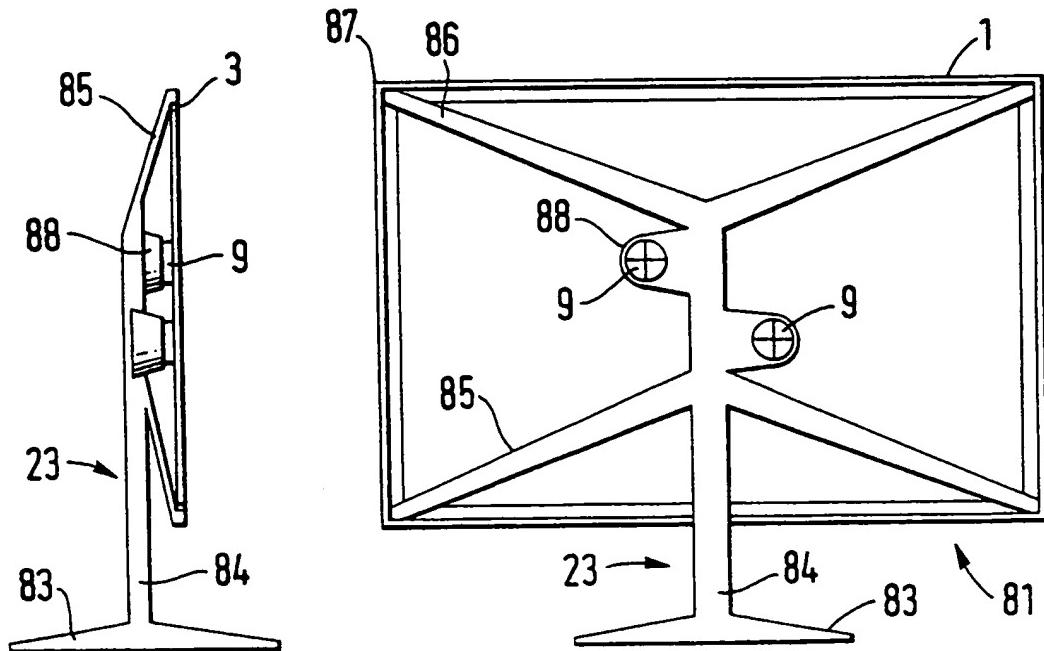


Fig. 7b

Fig. 7c

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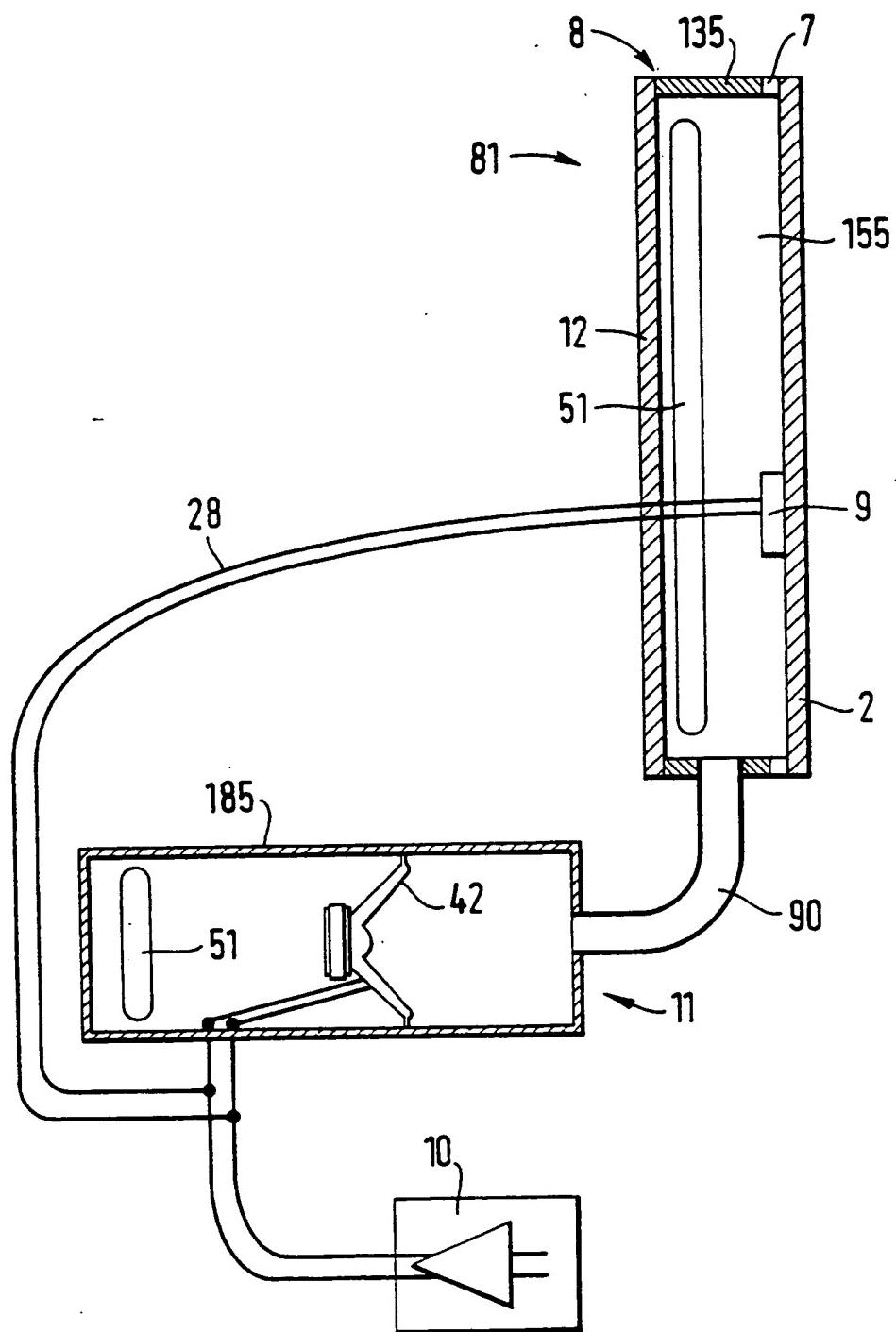


Fig. 8

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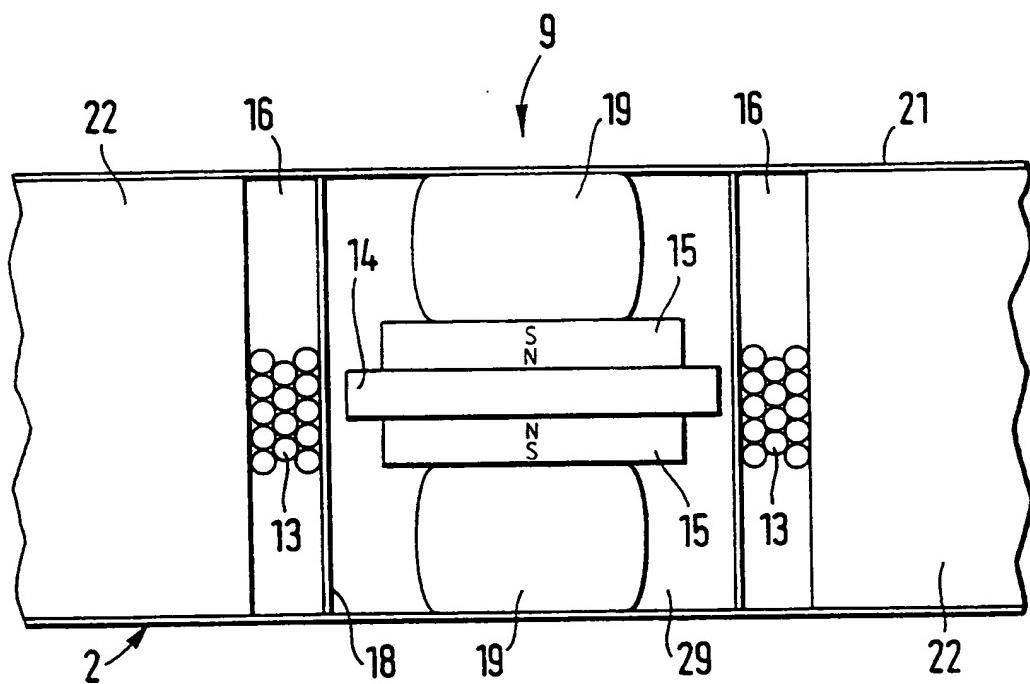


Fig. 9

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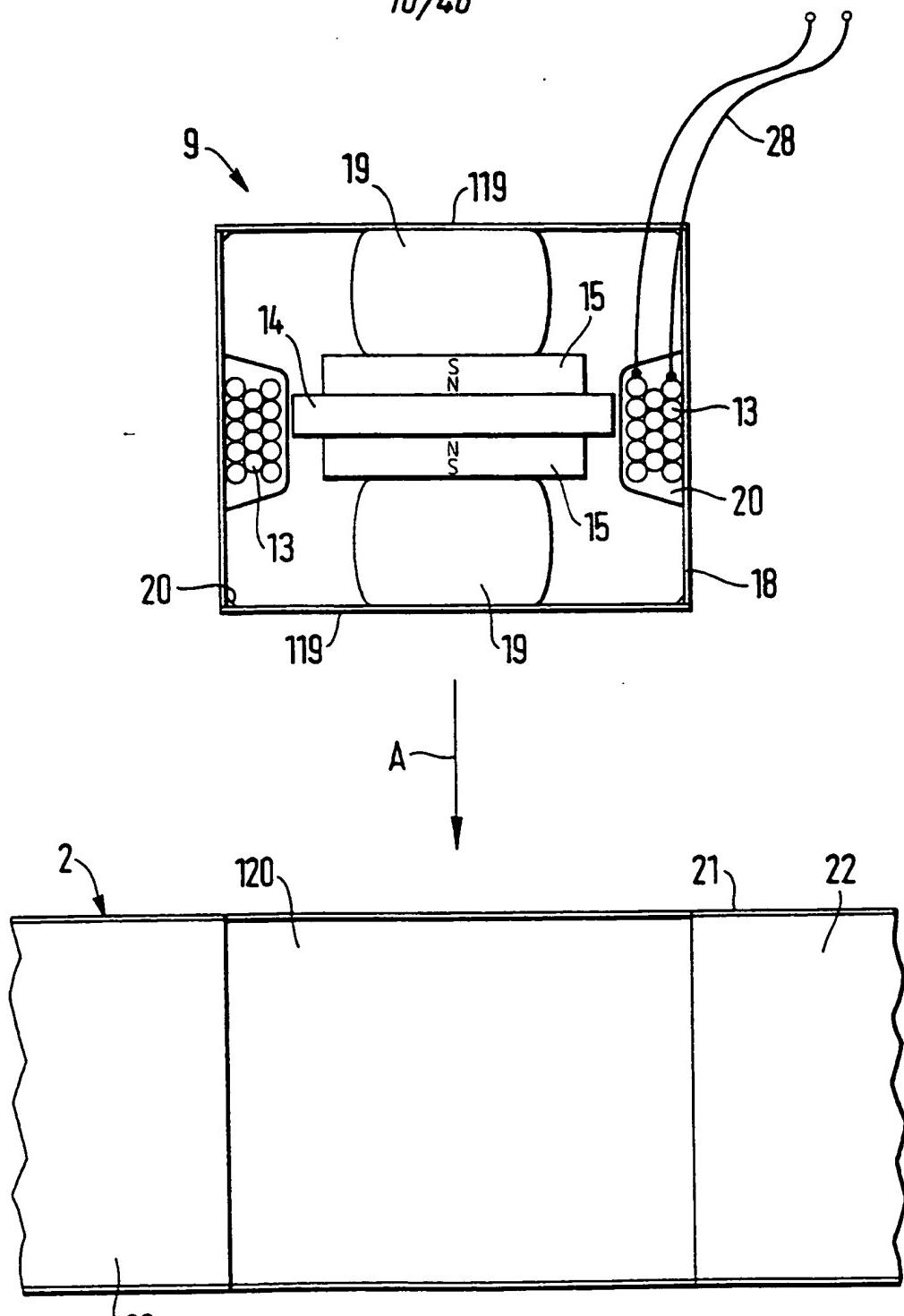


Fig. 10

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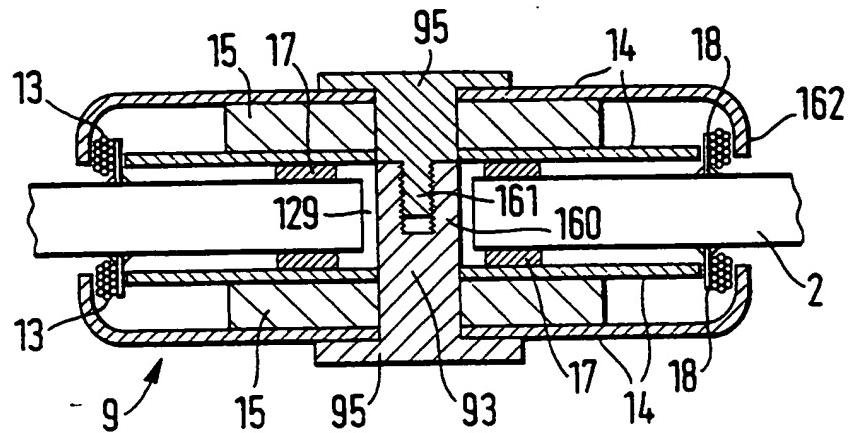


Fig. 11a

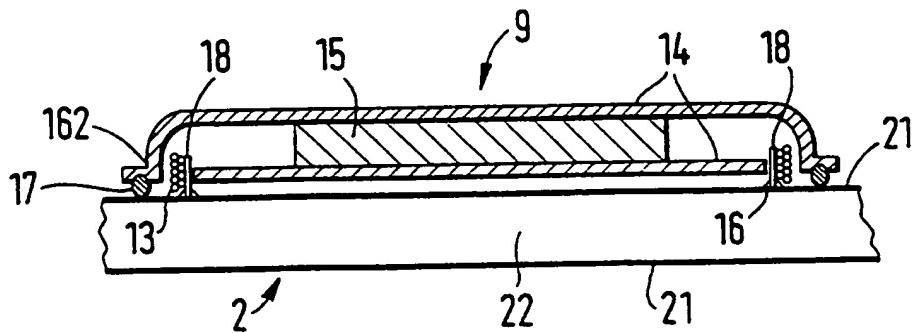


Fig. 11b

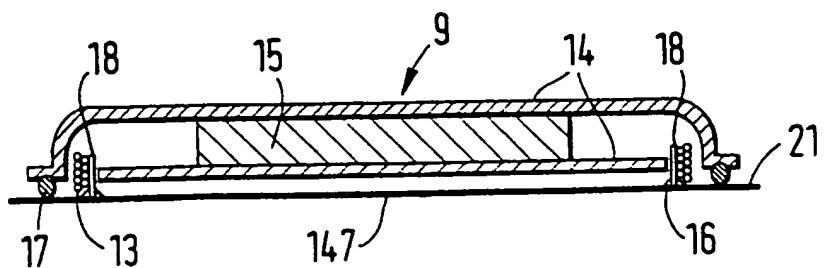


Fig. 11c

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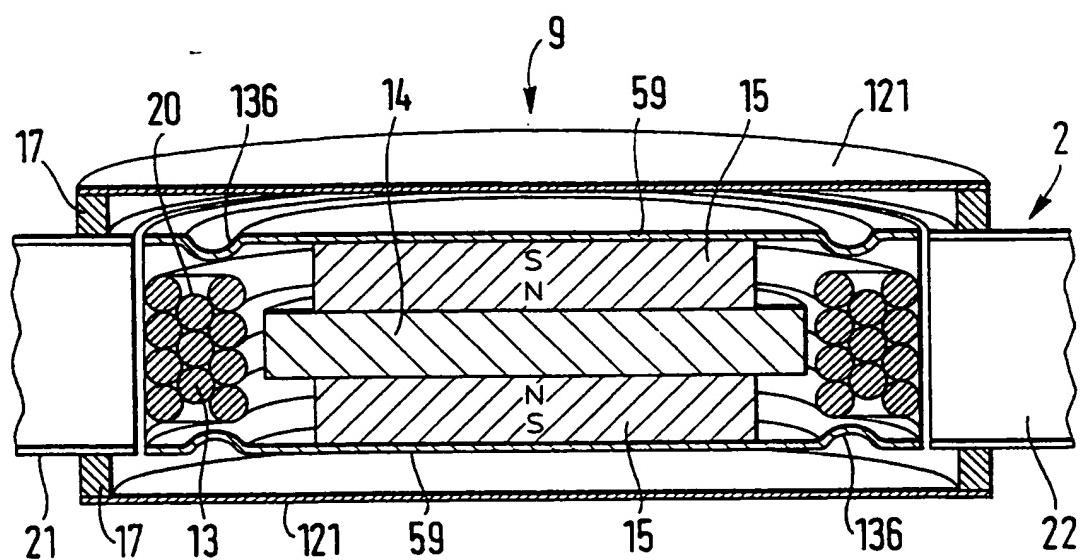


Fig. 12

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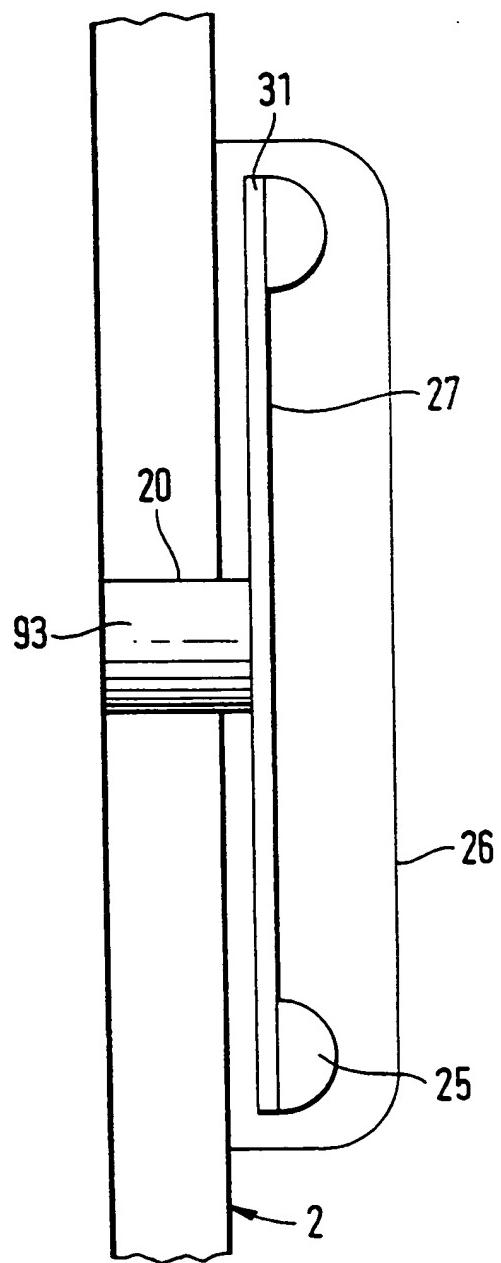


Fig. 13

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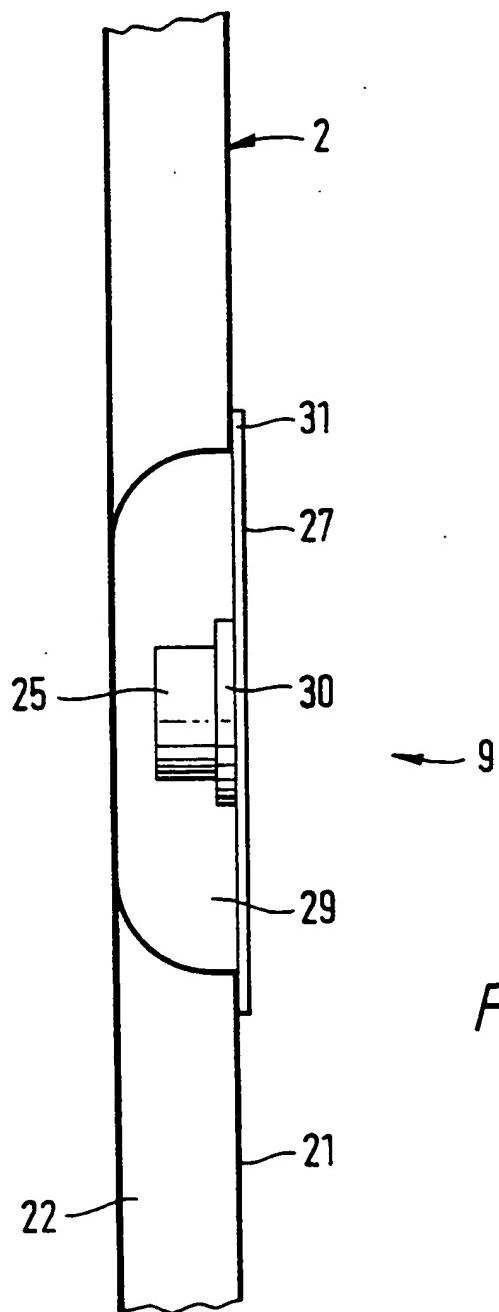


Fig. 14

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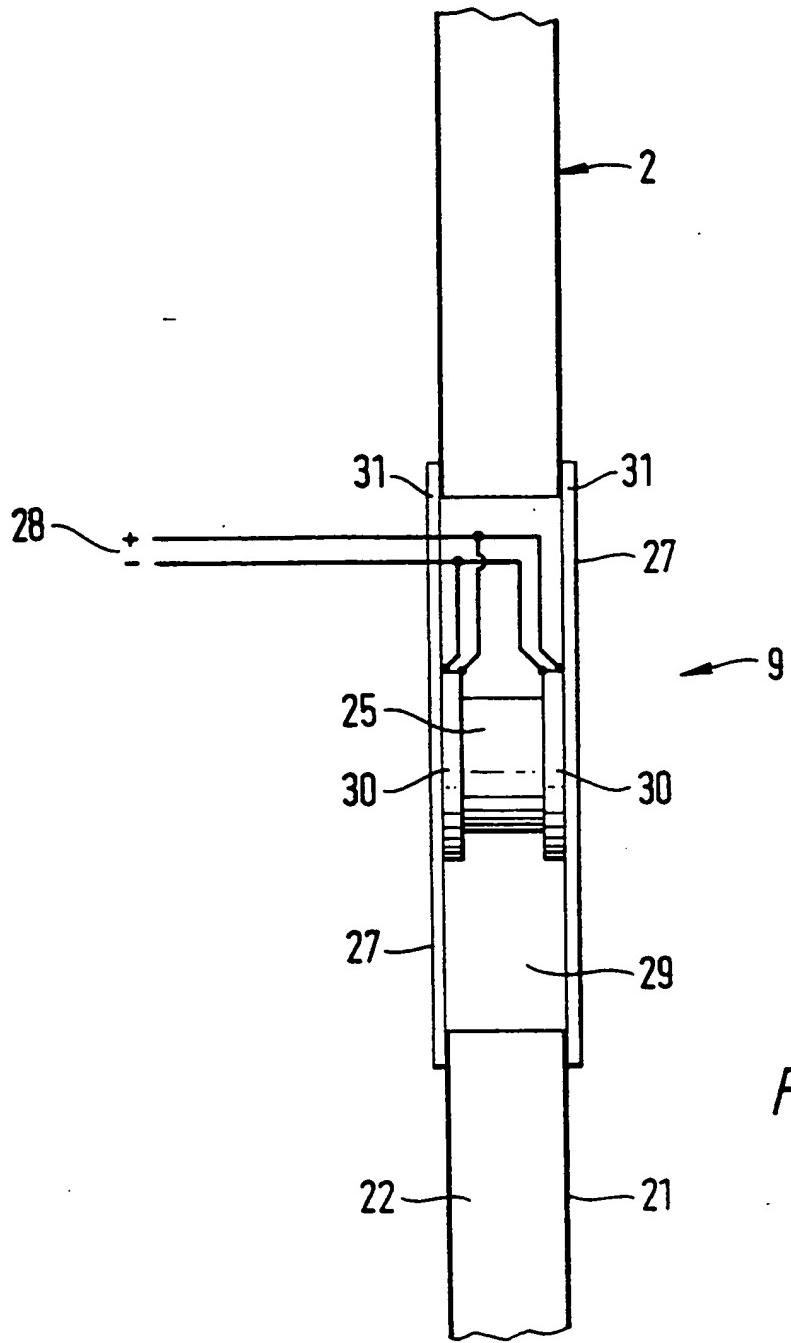


Fig. 15

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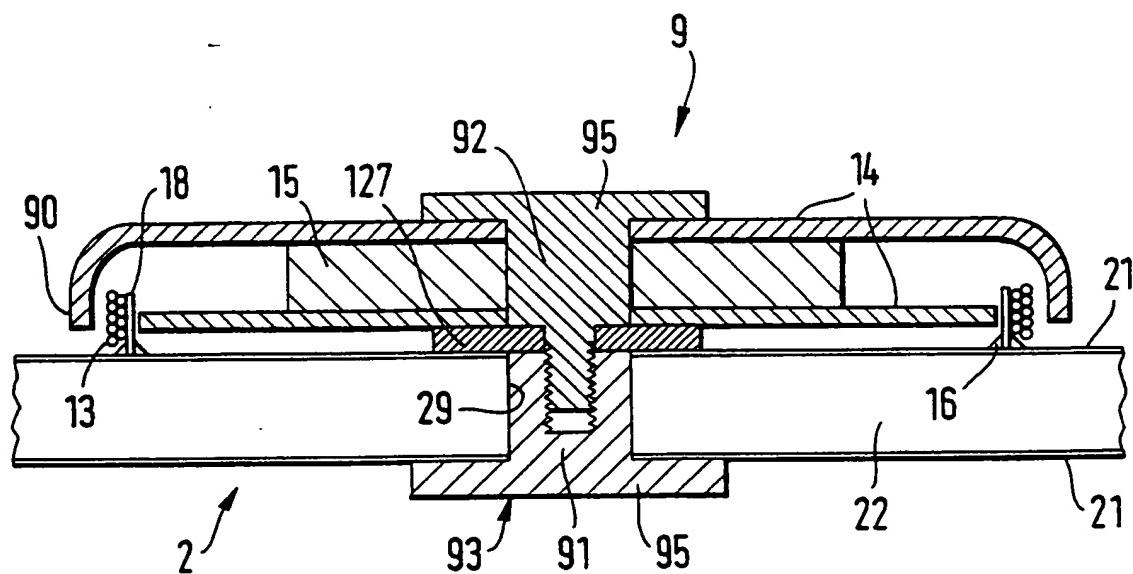


Fig. 16

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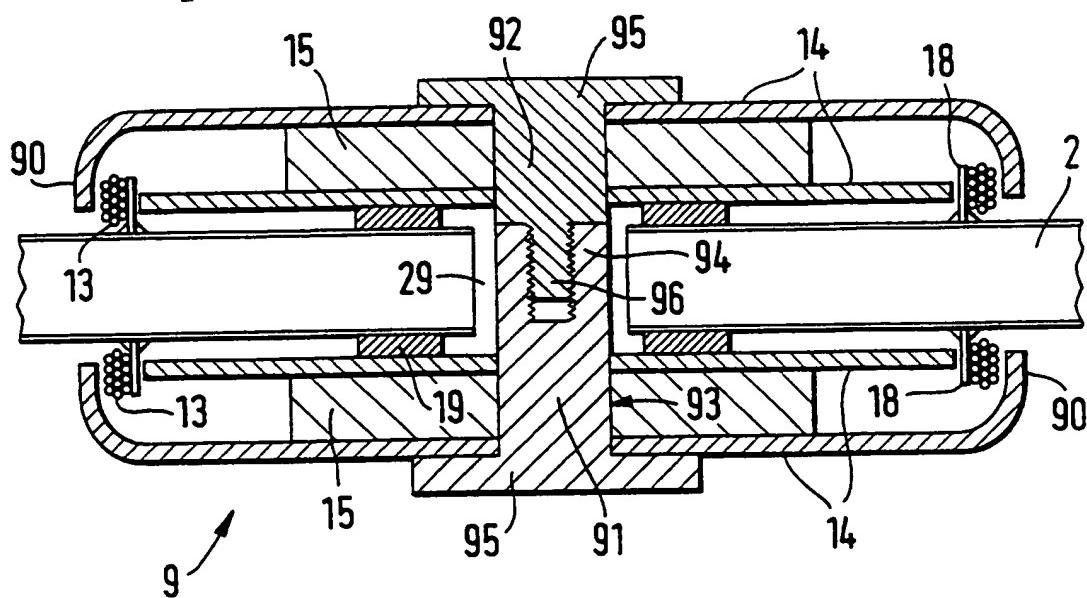


Fig. 17

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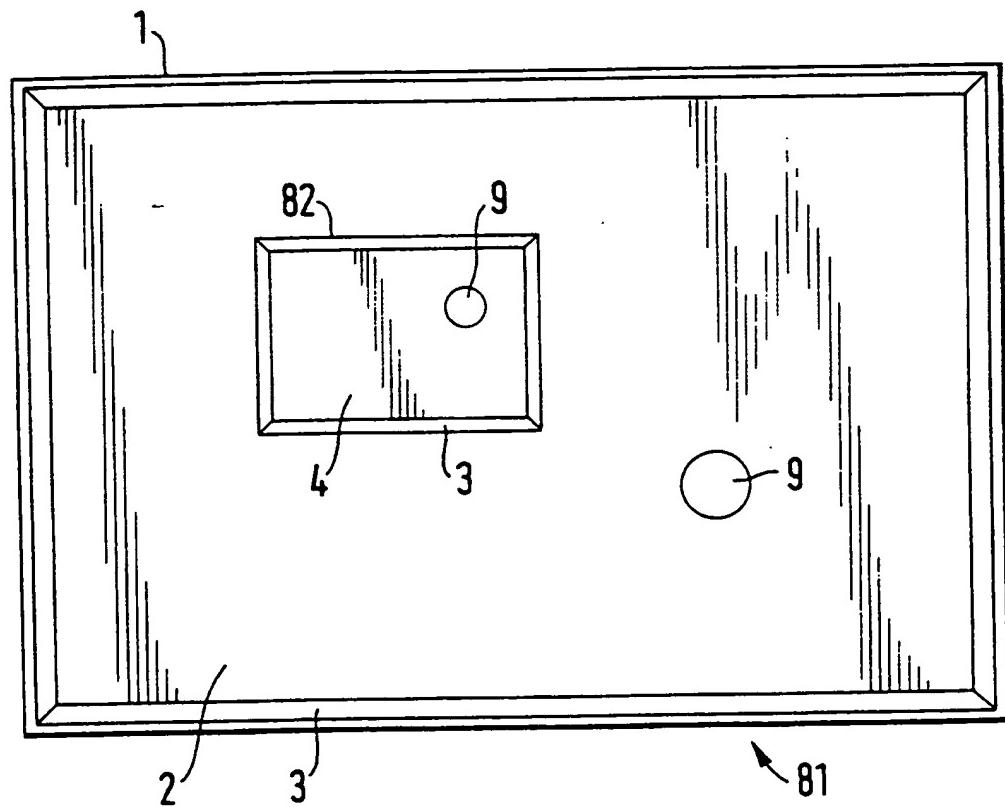


Fig. 18

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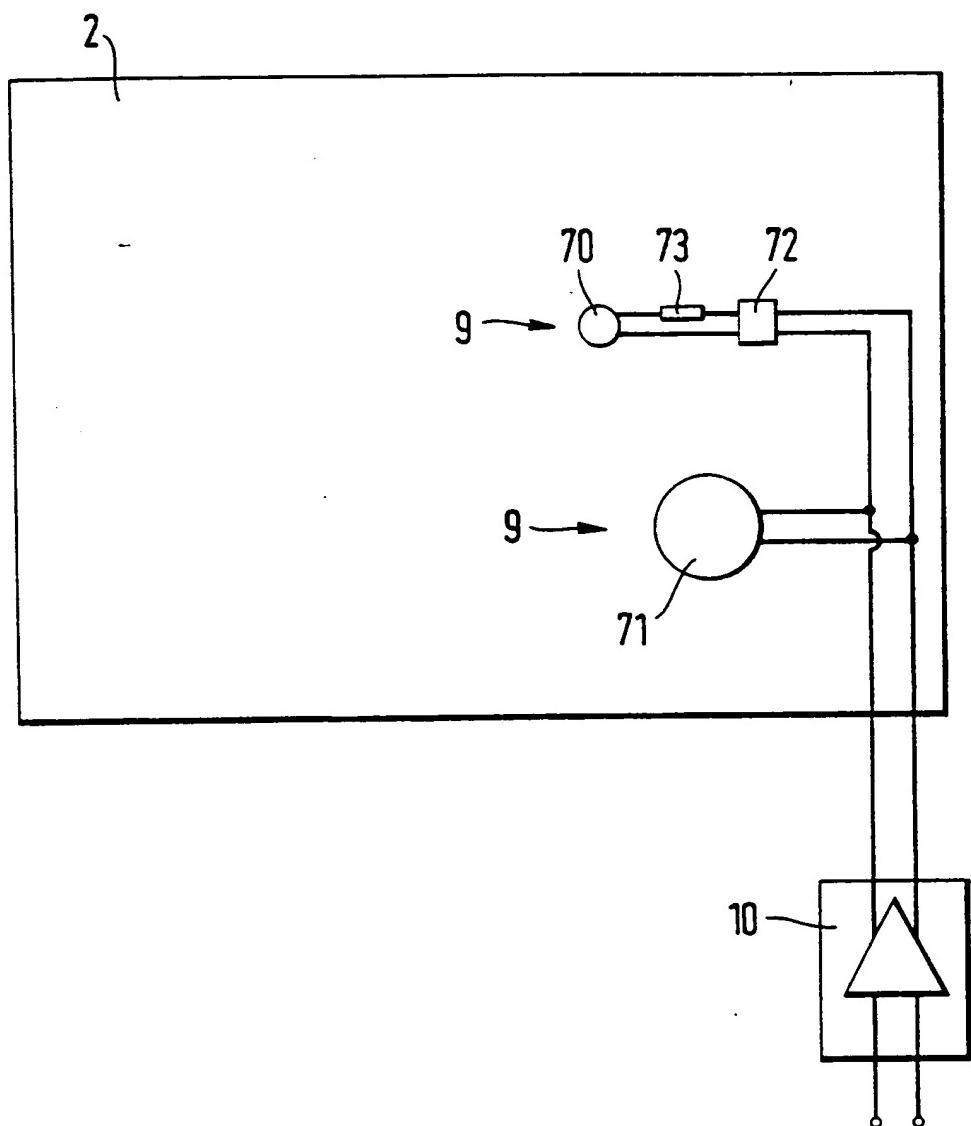


Fig. 19

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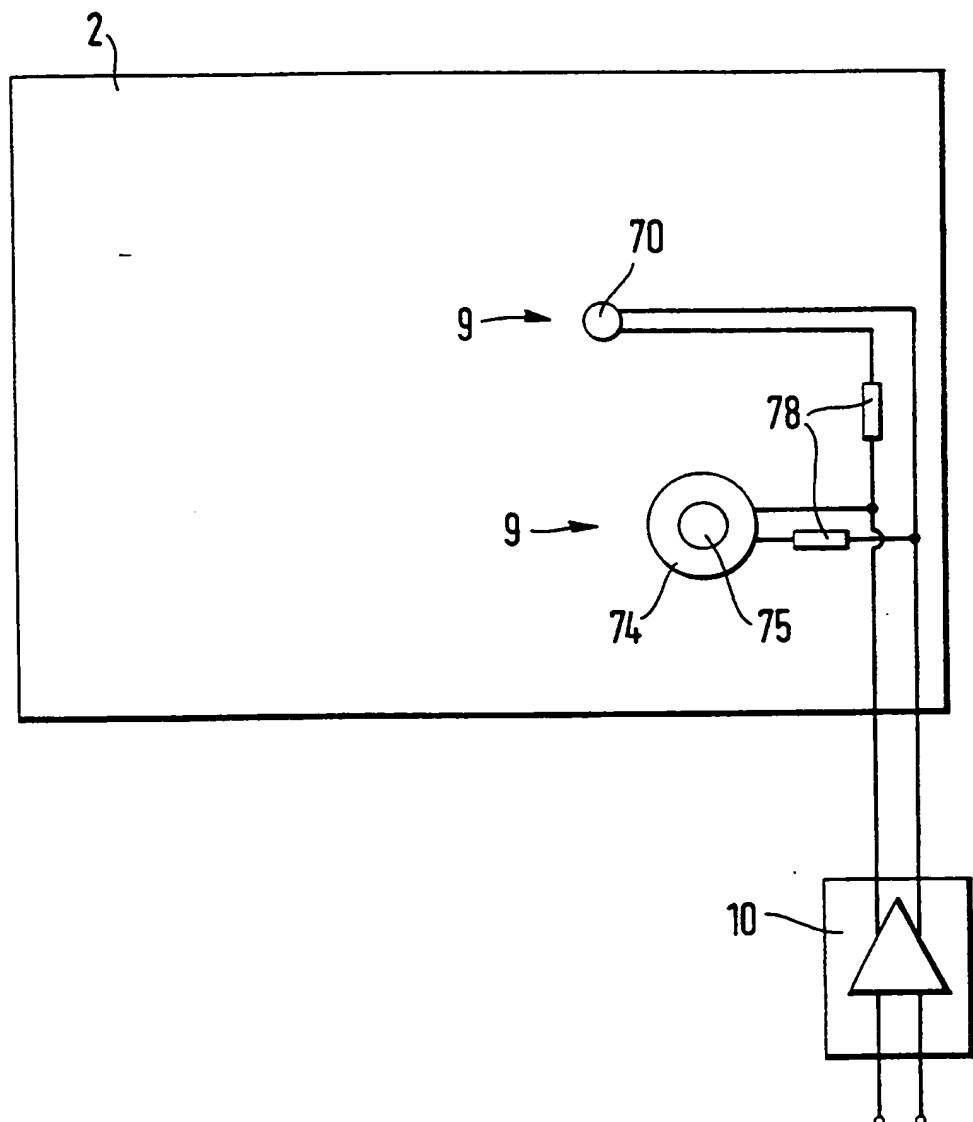


Fig.20

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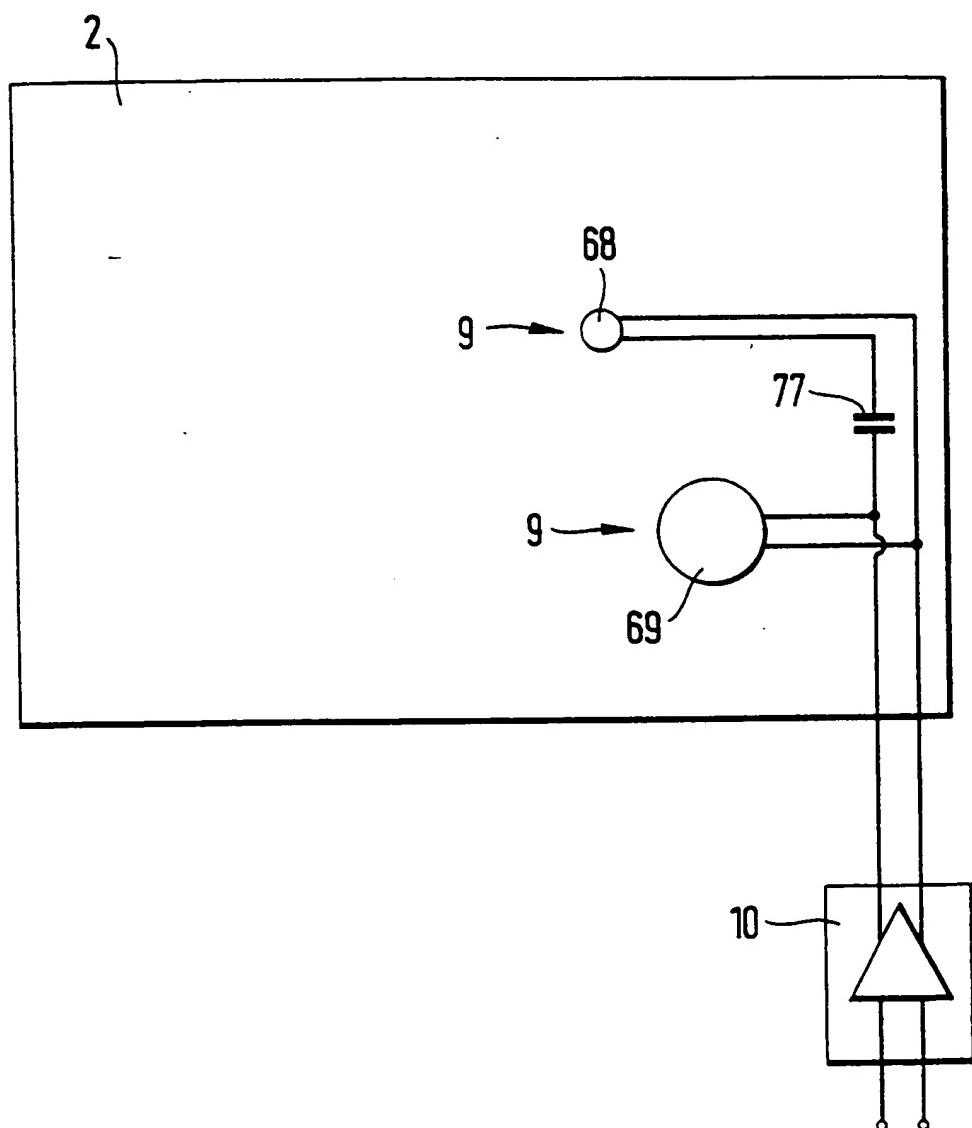


Fig.21

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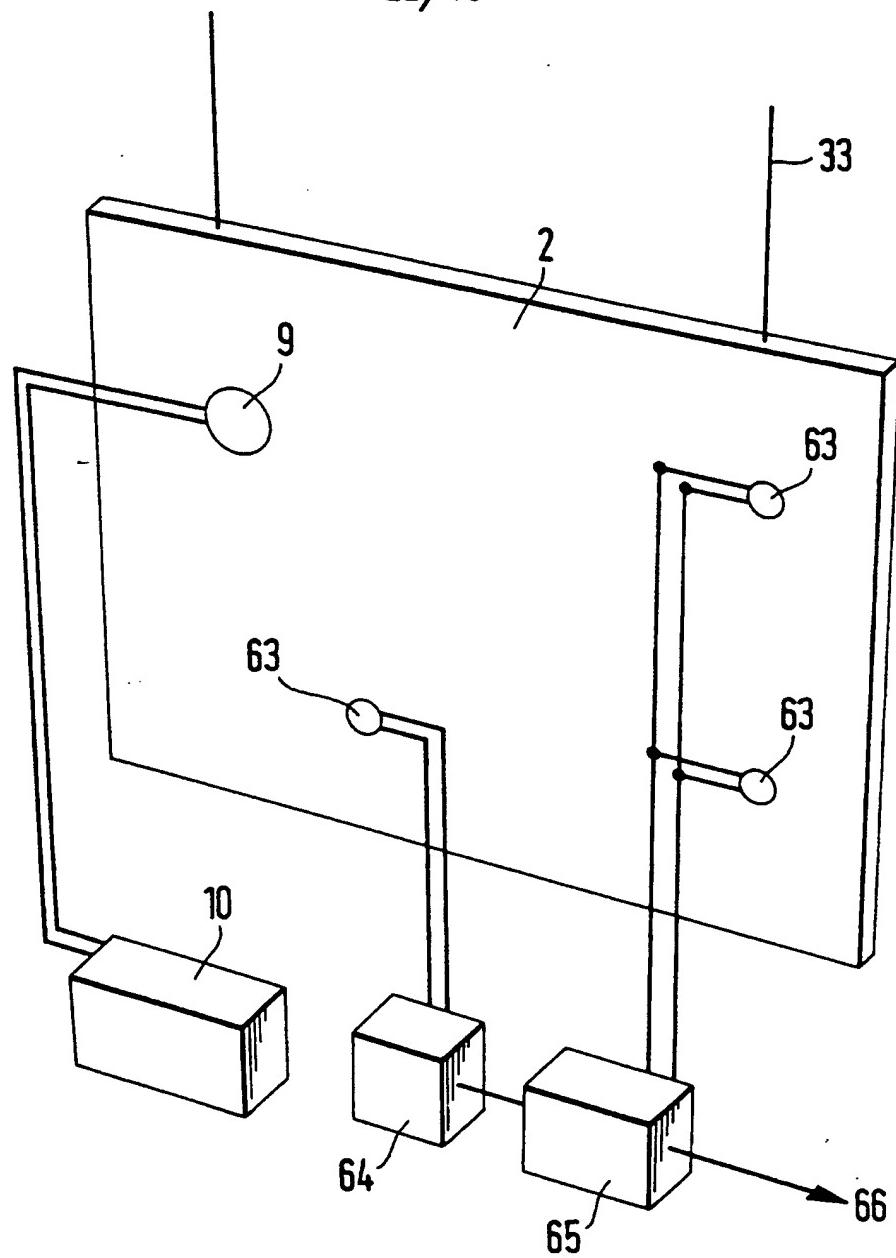


Fig. 22

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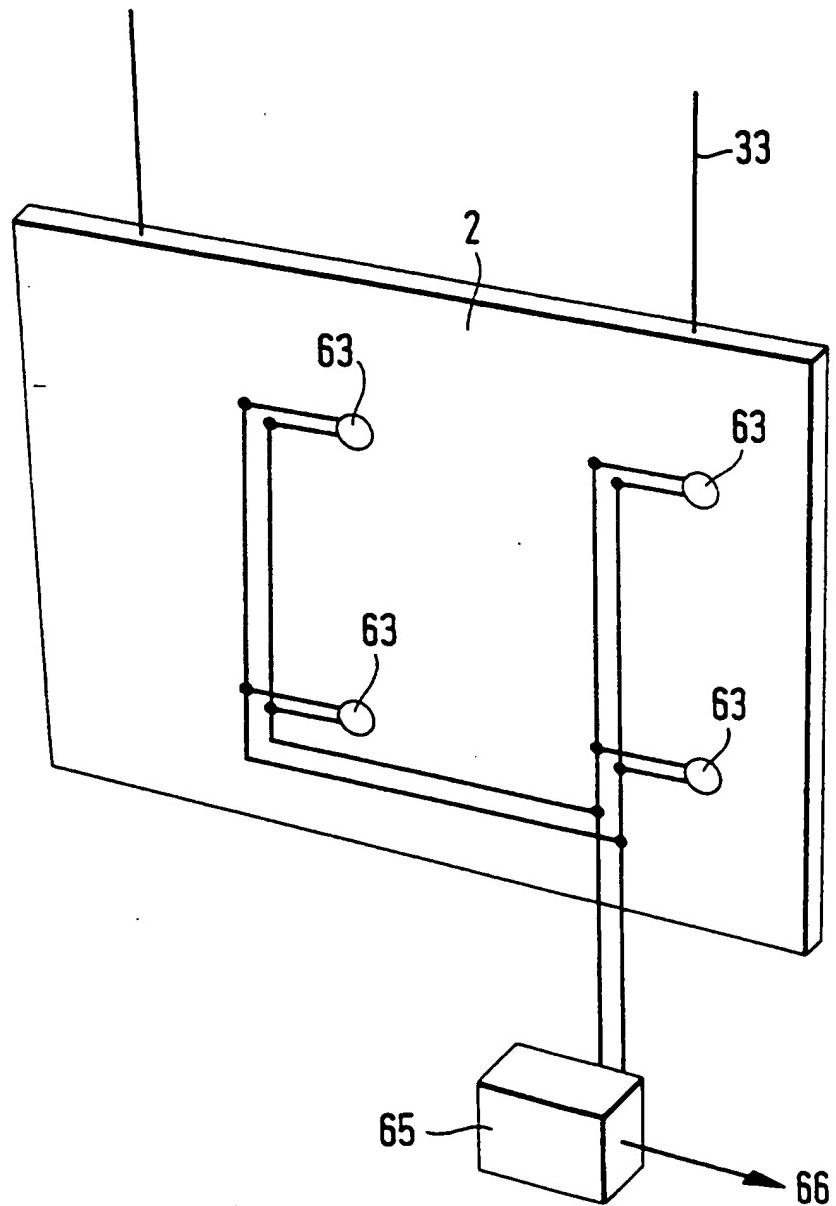


Fig. 23

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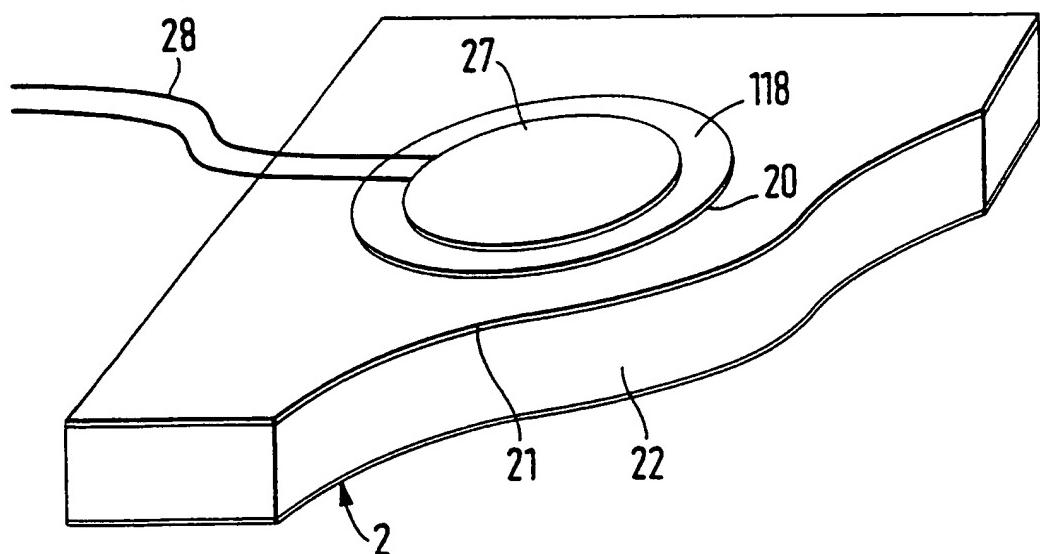


Fig.24

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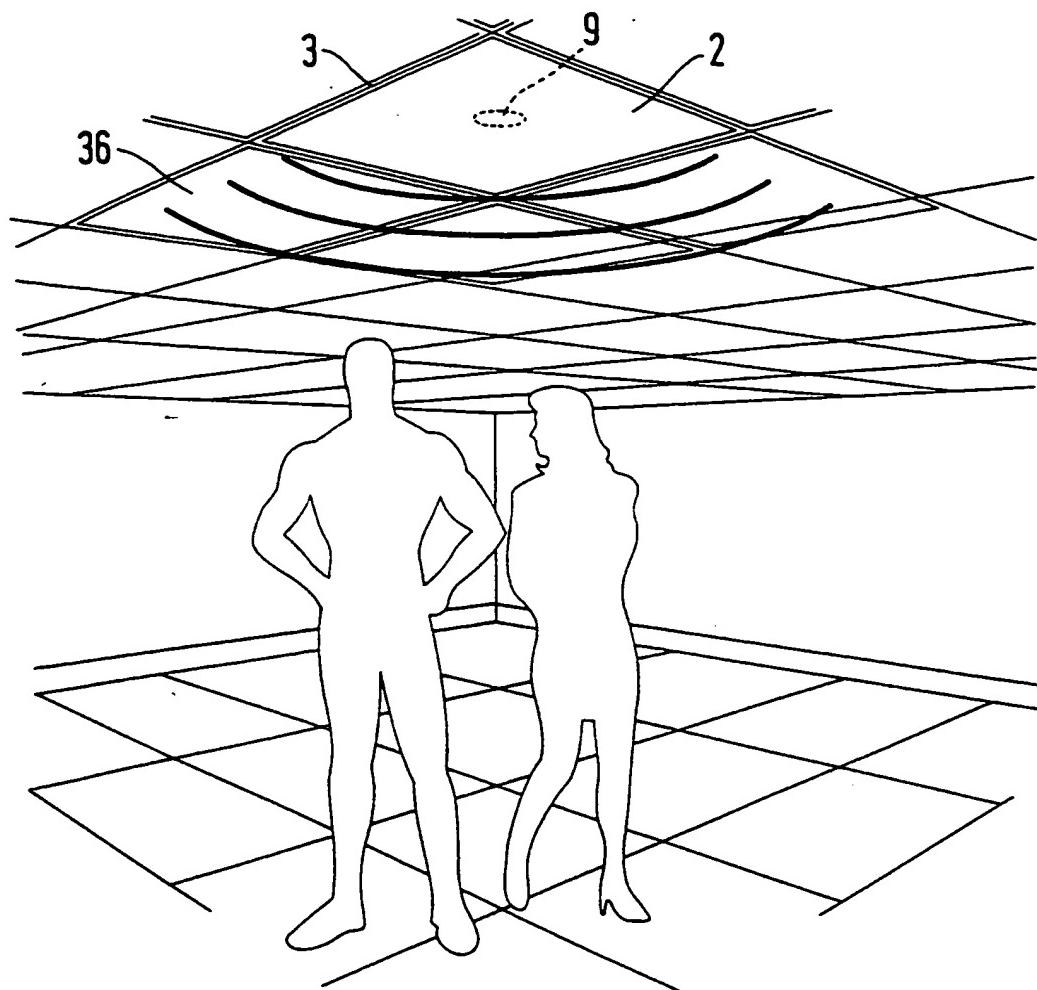


Fig. 25a

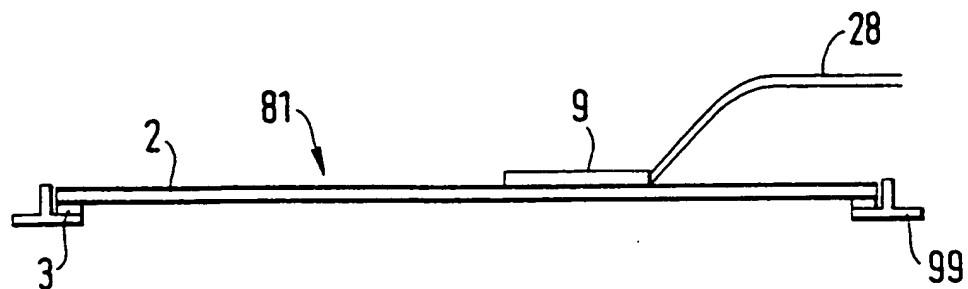


Fig. 25b

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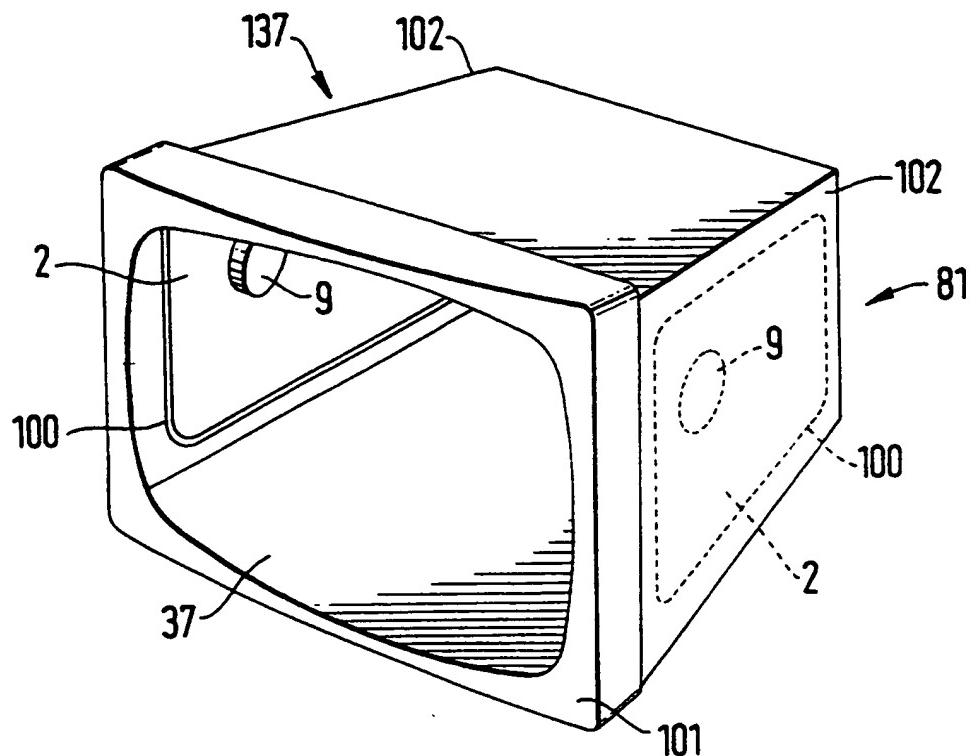


Fig. 27

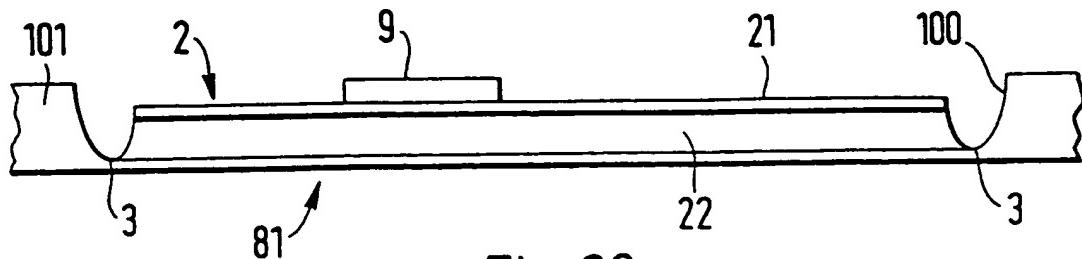


Fig. 28

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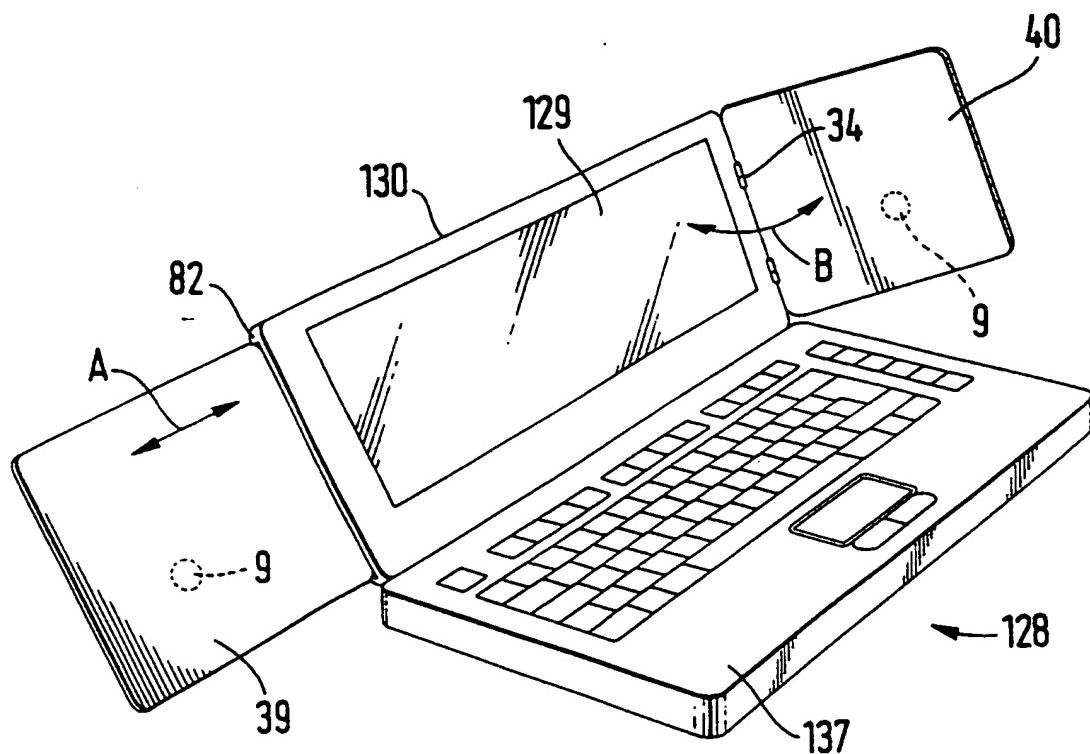


Fig. 29

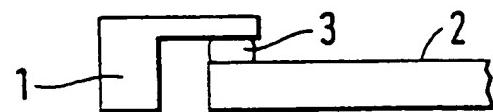


Fig. 30

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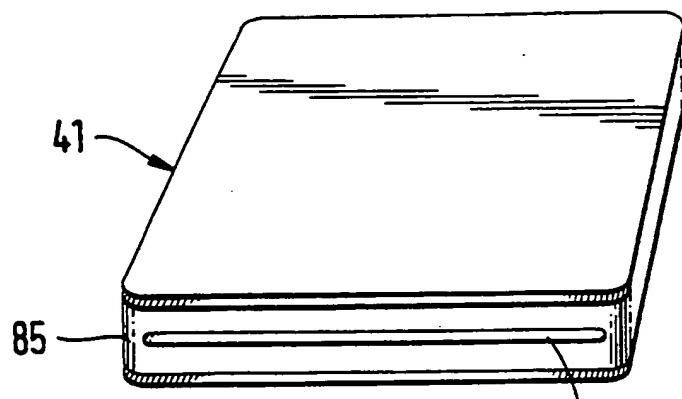


Fig. 31

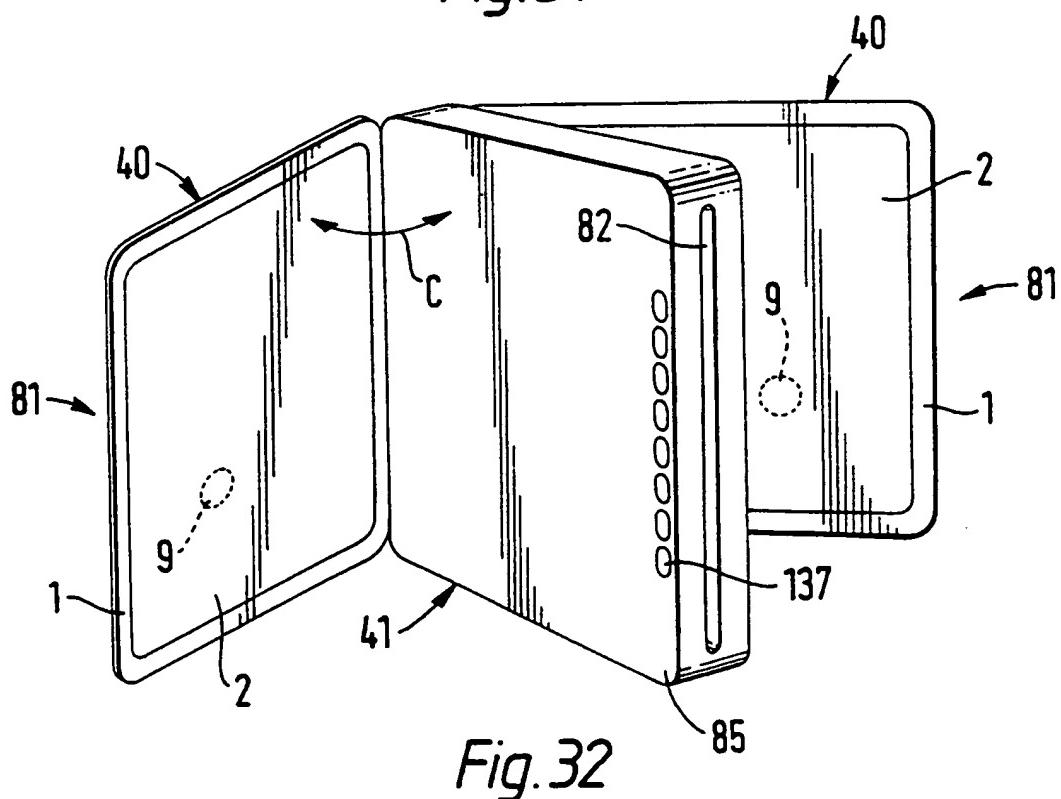


Fig. 32

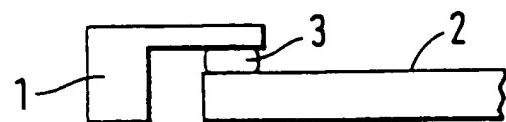


Fig. 33

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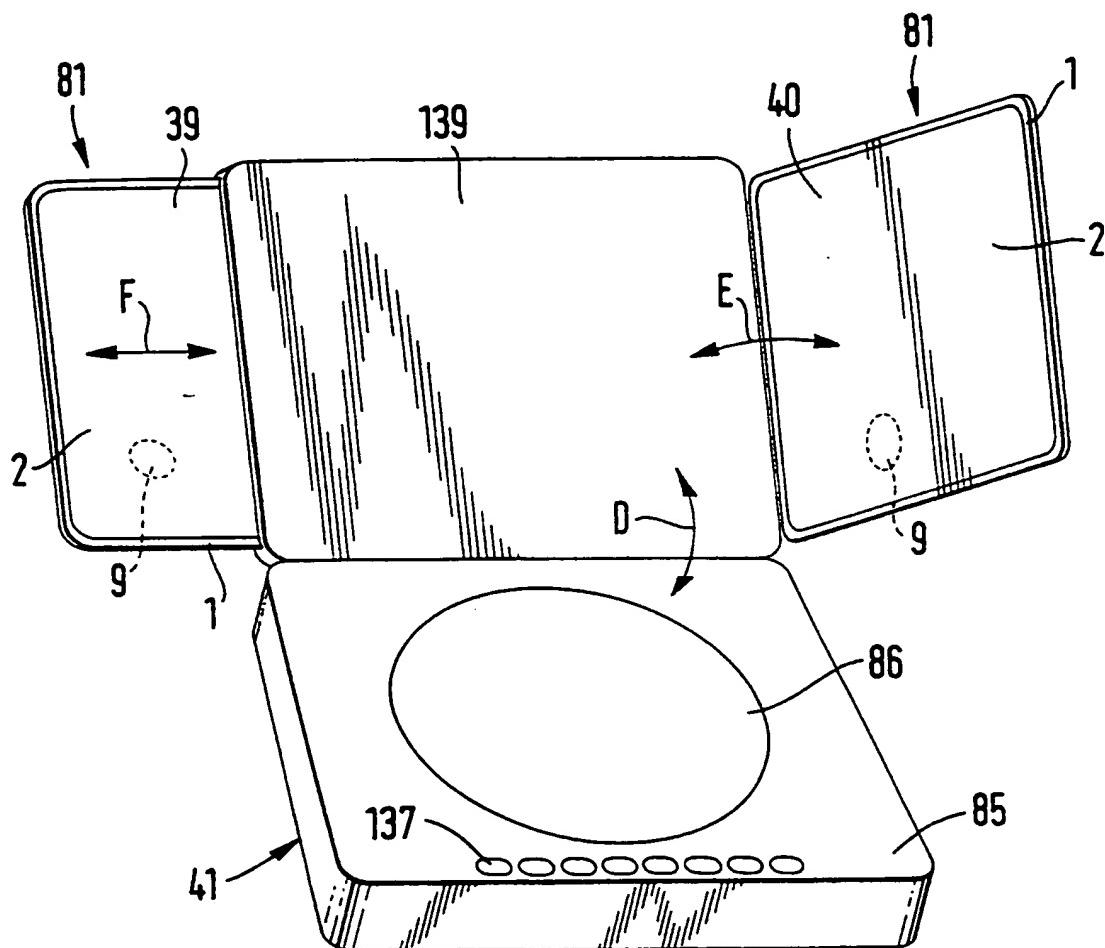


Fig. 34

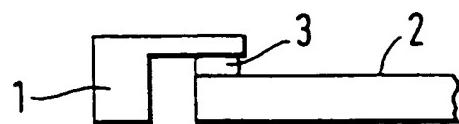


Fig. 35

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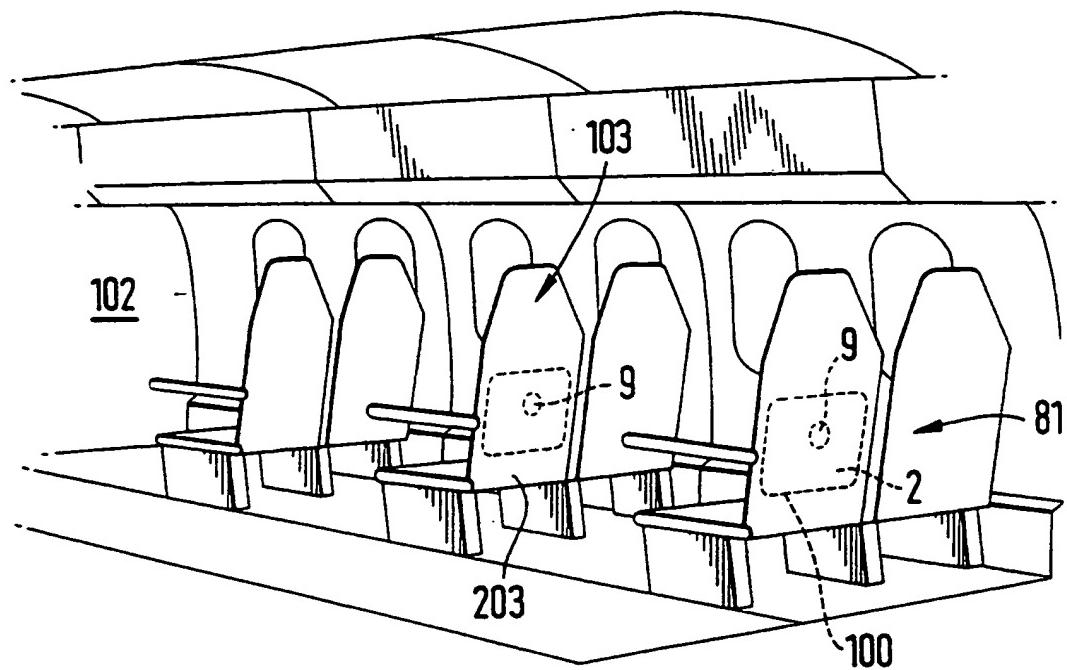


Fig. 36

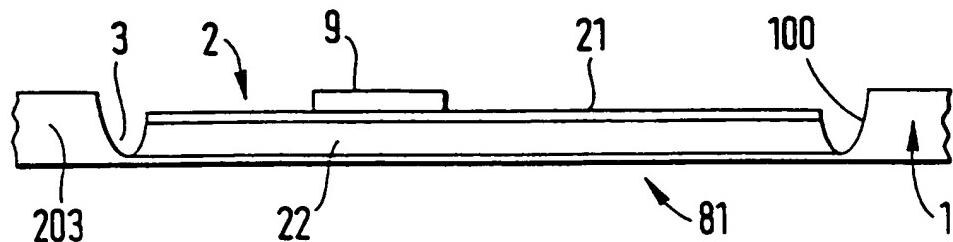


Fig. 37

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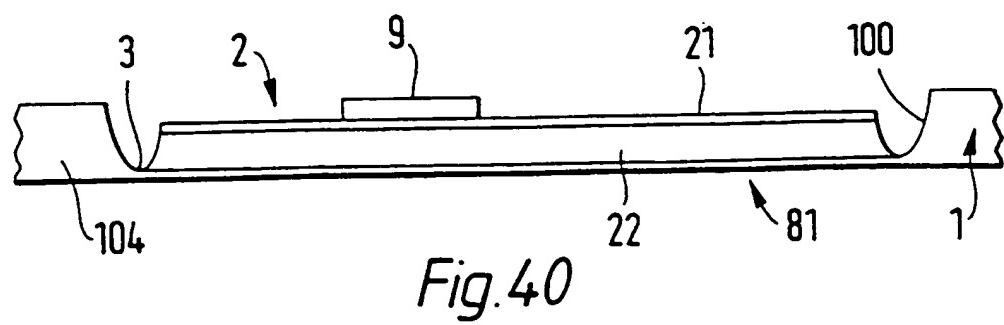
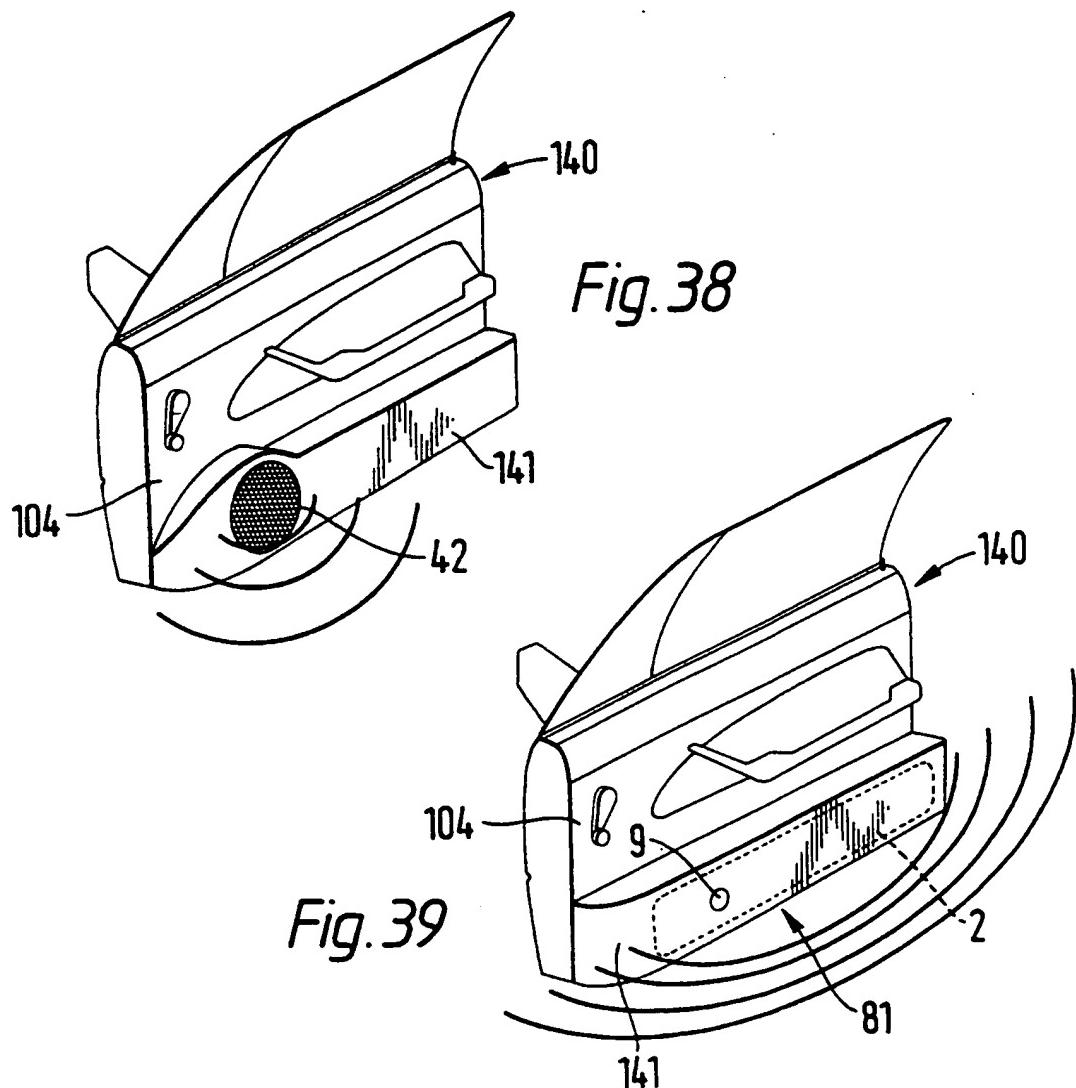


Fig. 40

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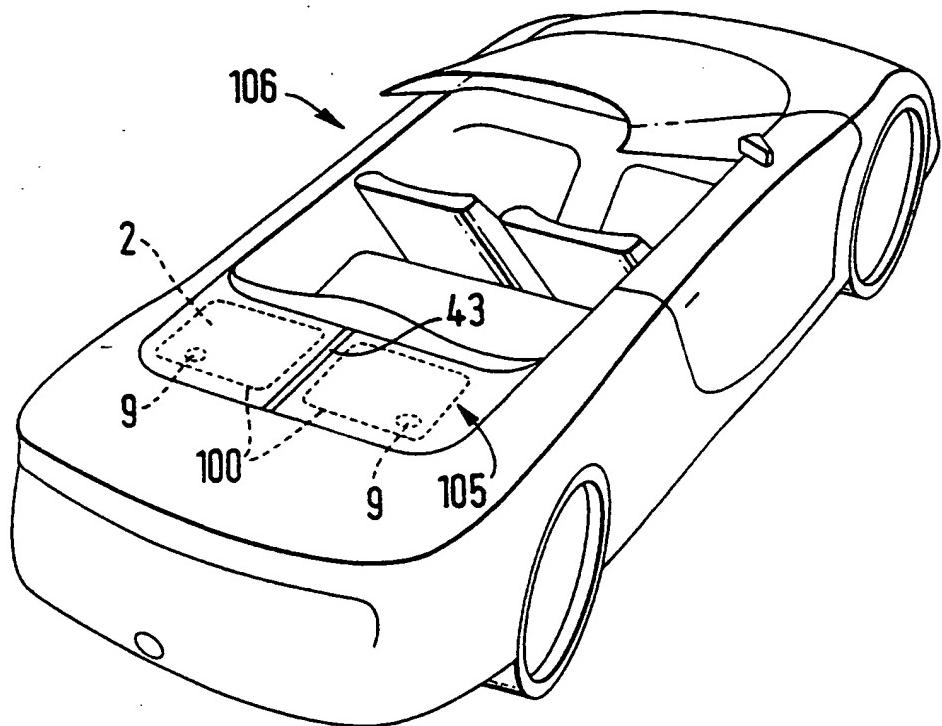


Fig. 41

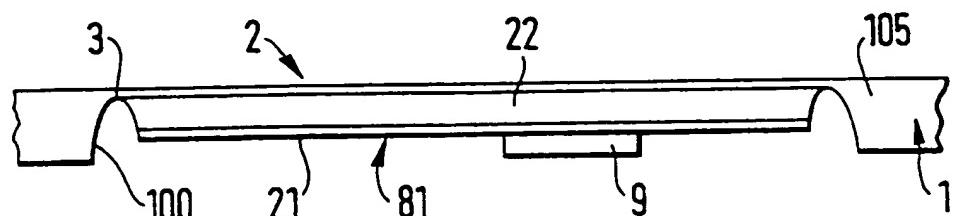


Fig. 42

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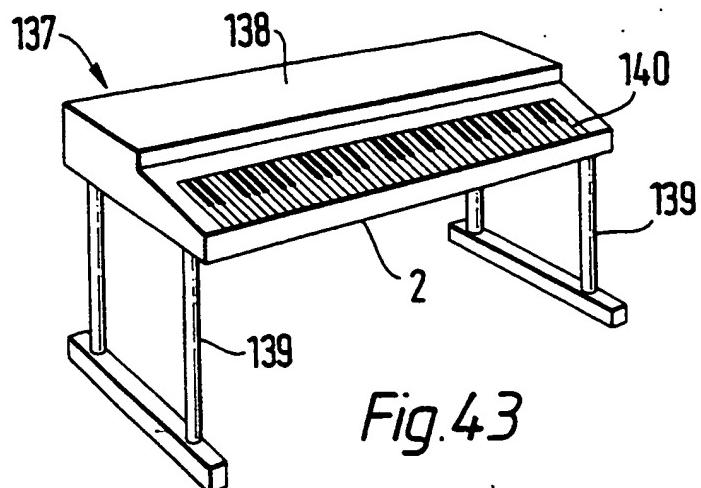


Fig. 43

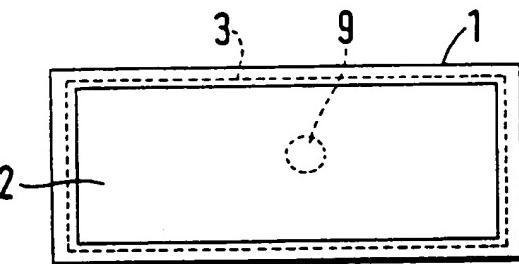


Fig. 44

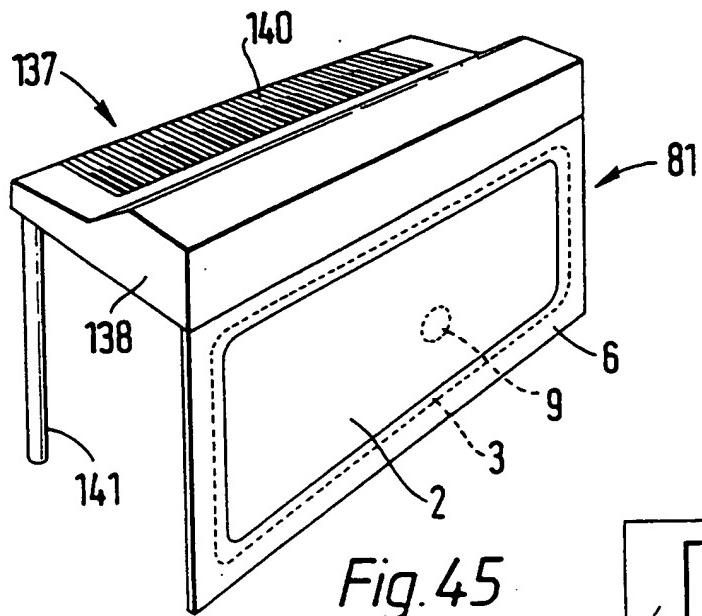


Fig. 45

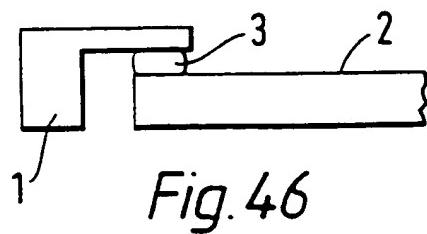


Fig. 46

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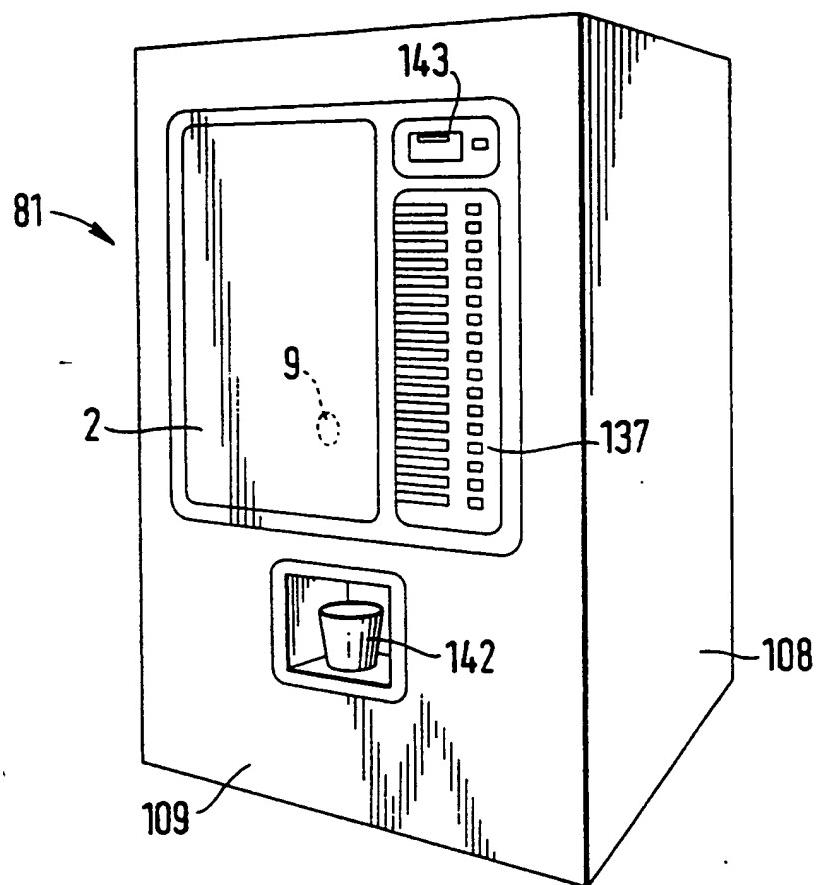


Fig. 47

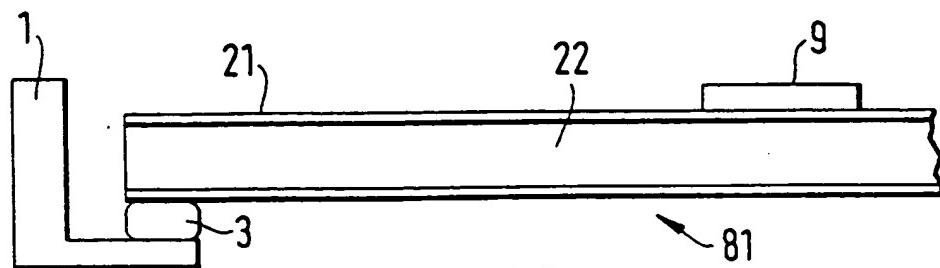


Fig. 48

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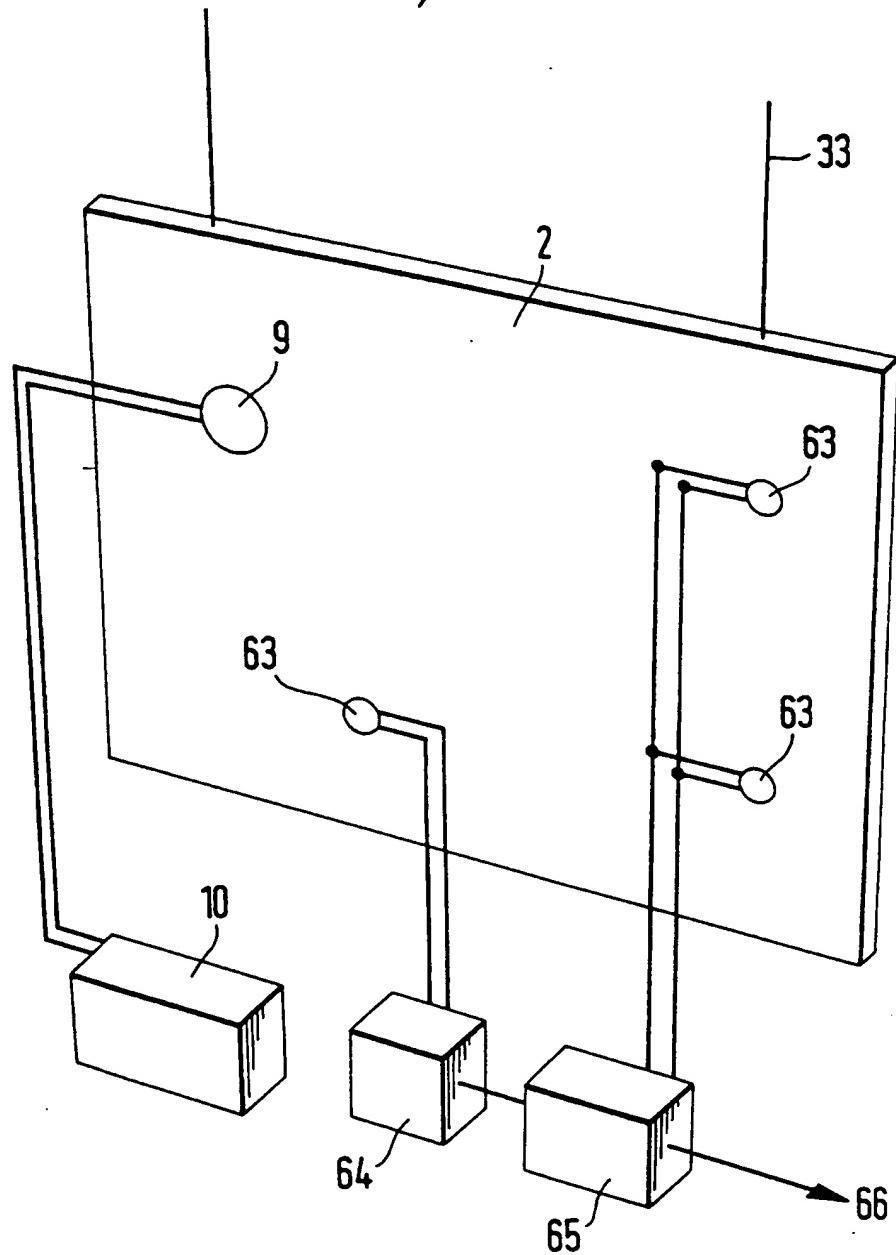


Fig. 49

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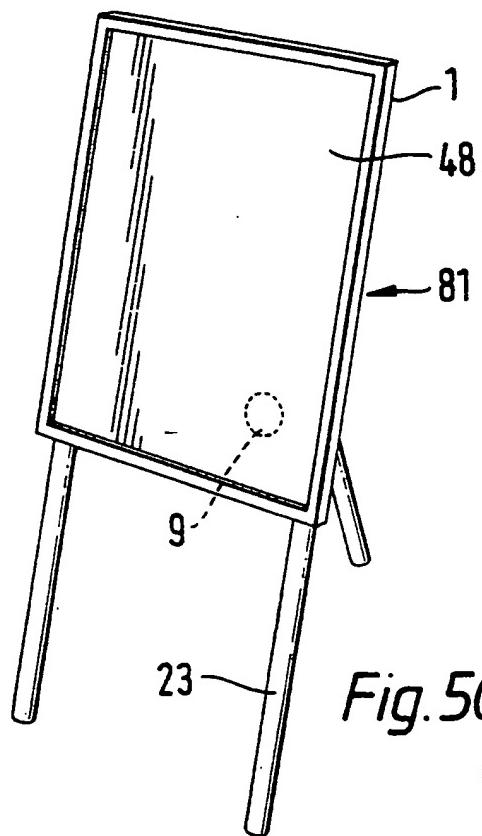


Fig. 50

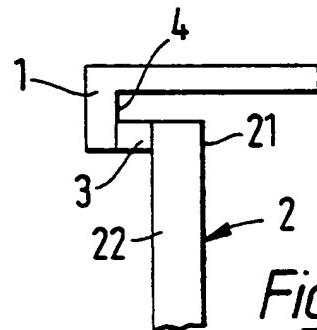


Fig. 52

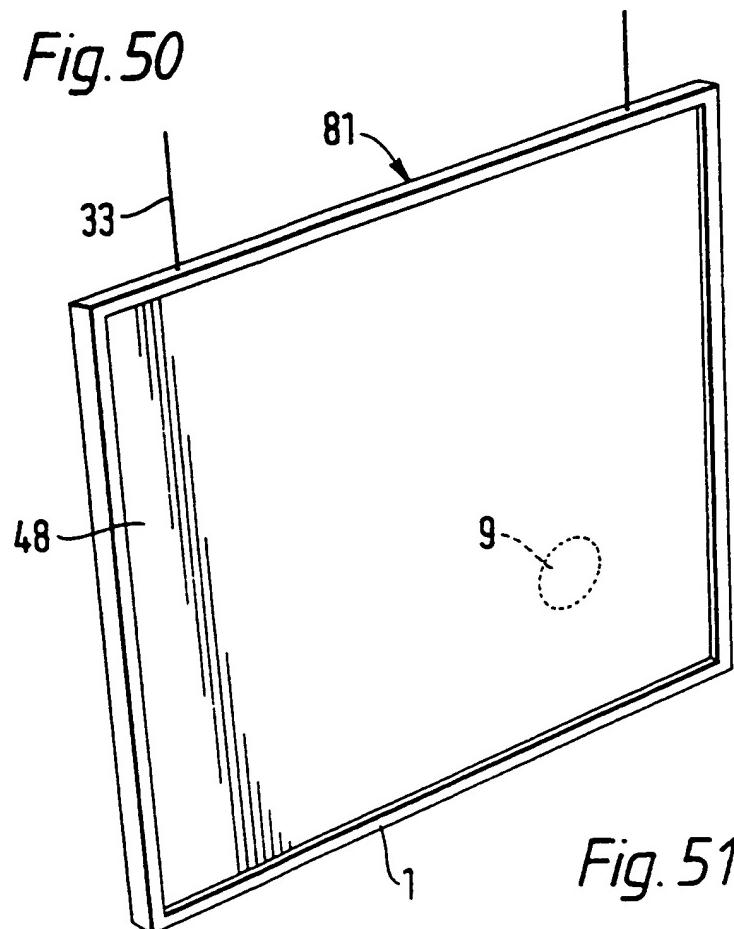


Fig. 51

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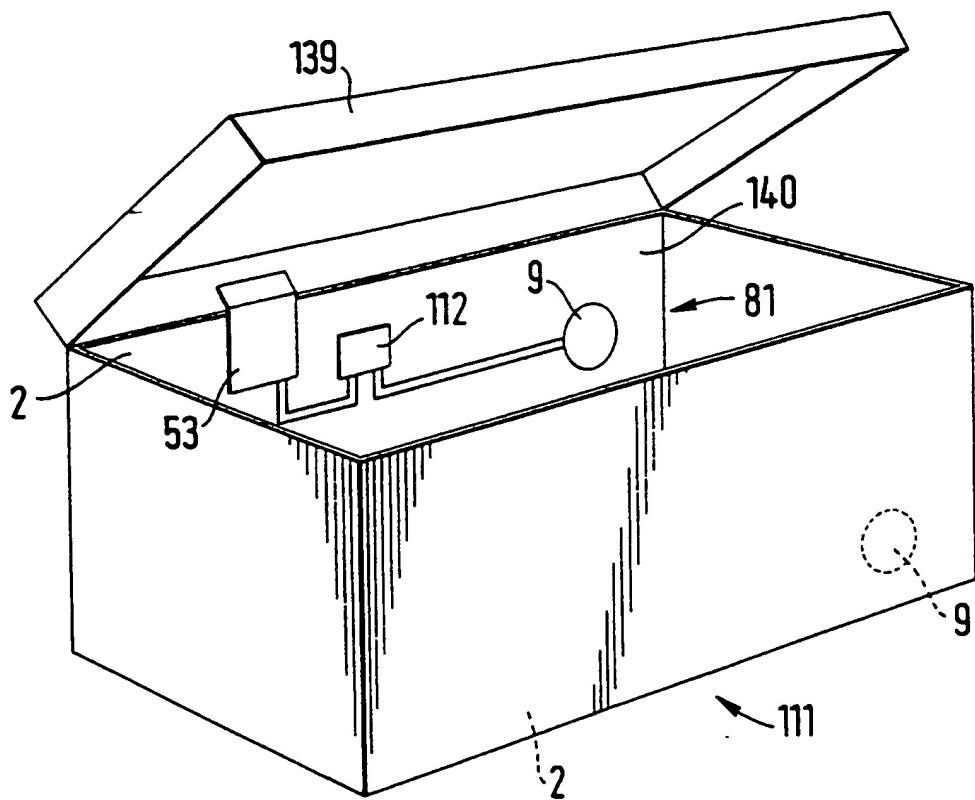


Fig. 53

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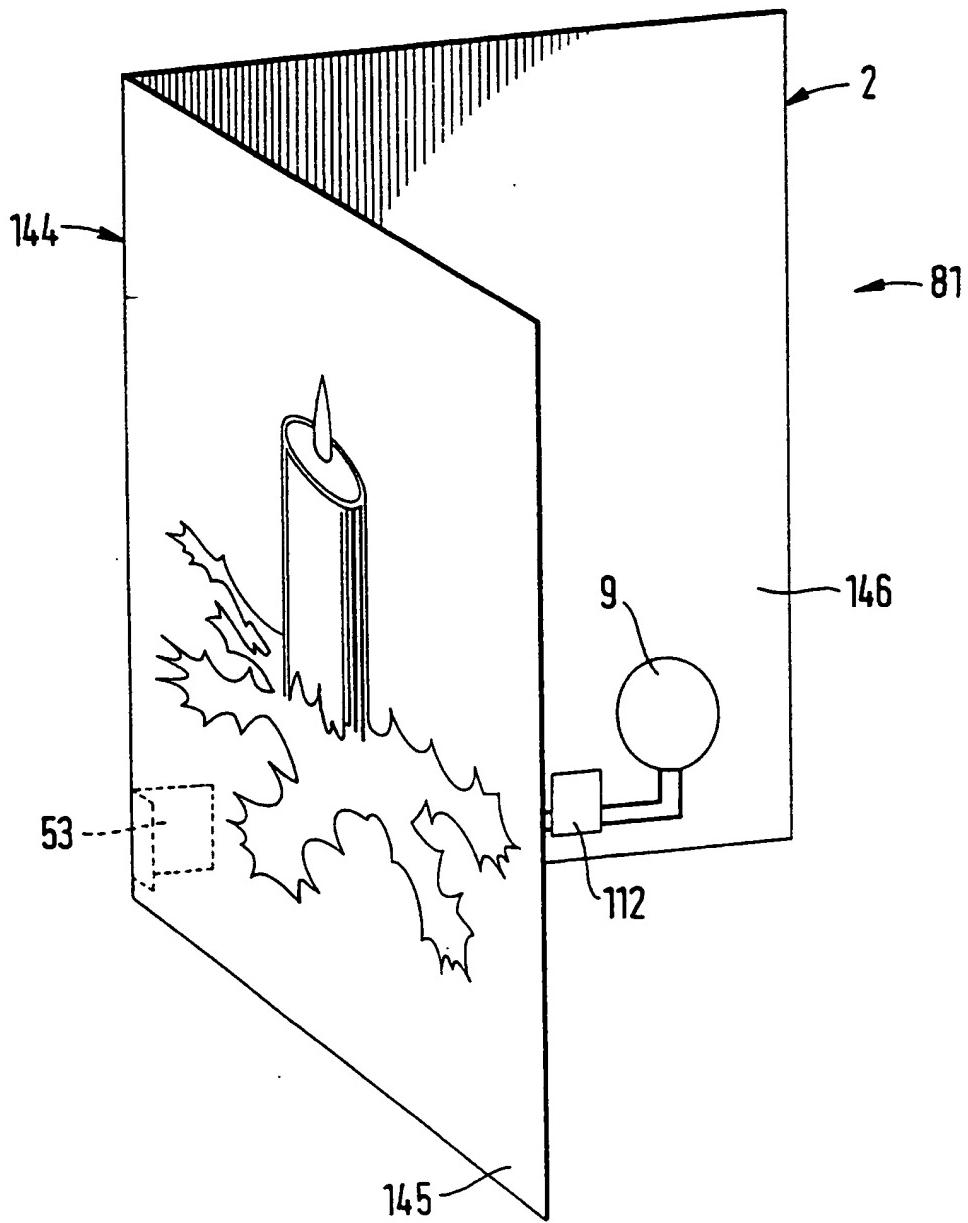


Fig. 54

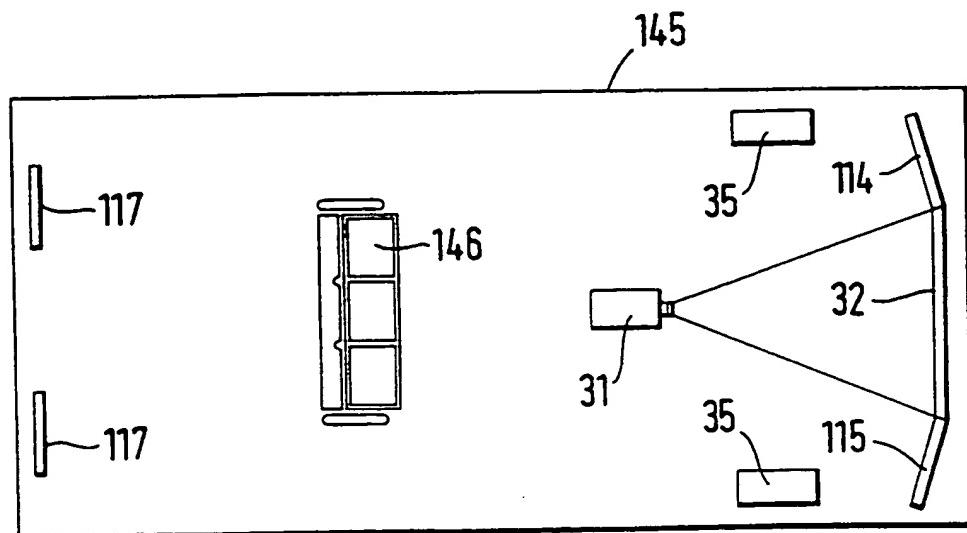
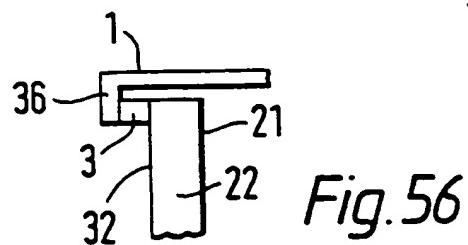
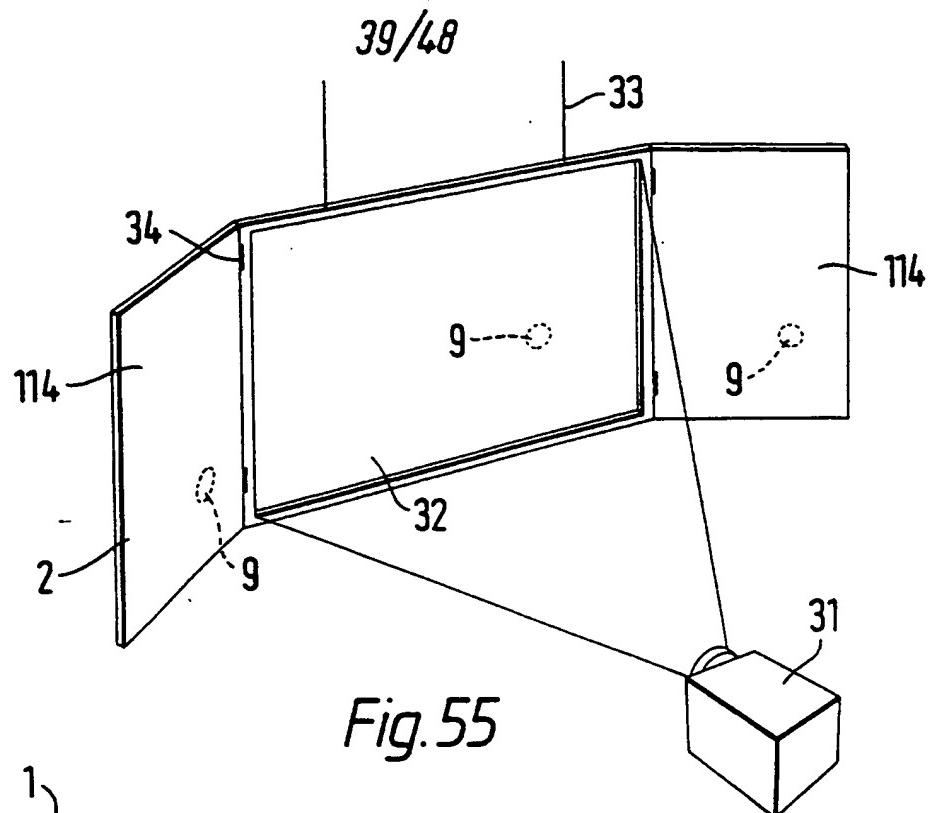


Fig. 57

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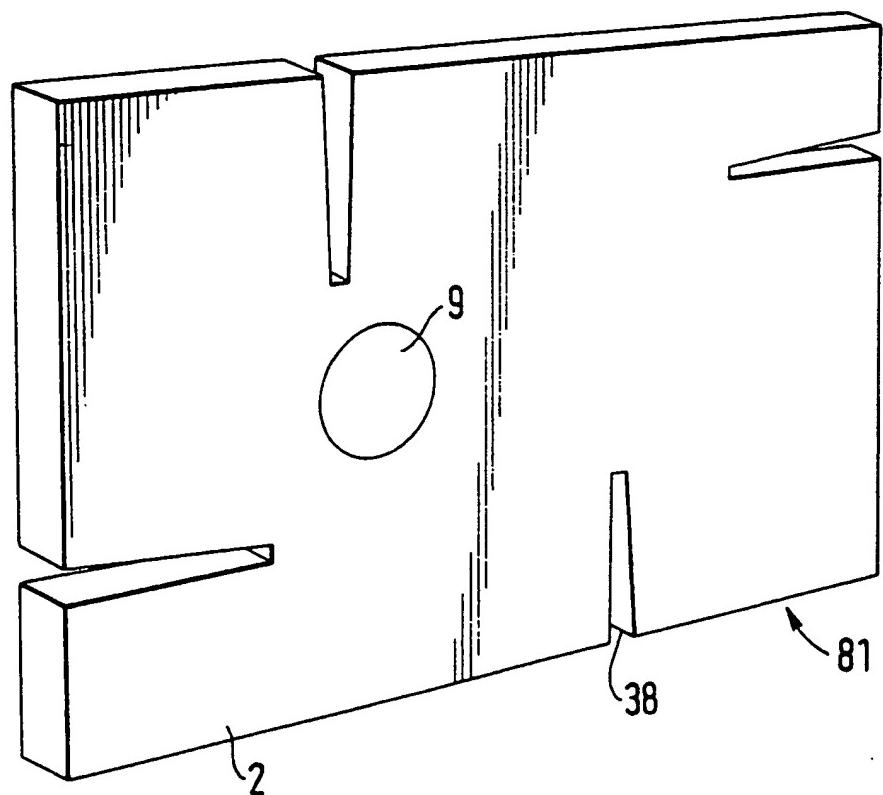


Fig. 58

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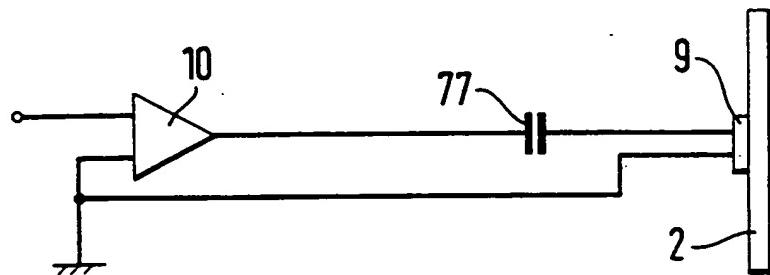


Fig. 59a

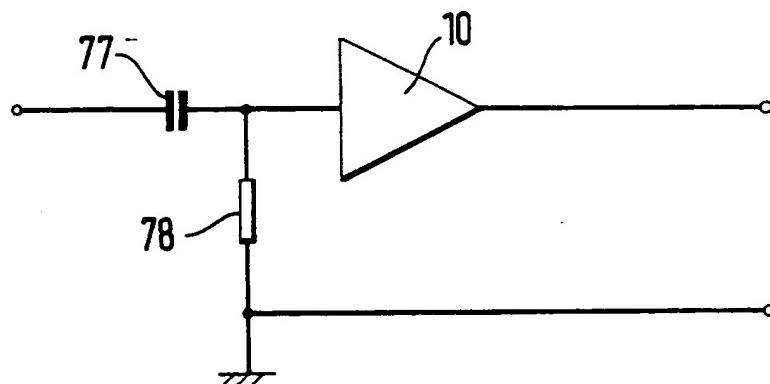


Fig. 59b

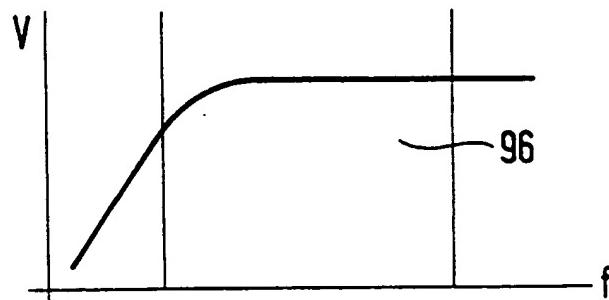


Fig. 59c

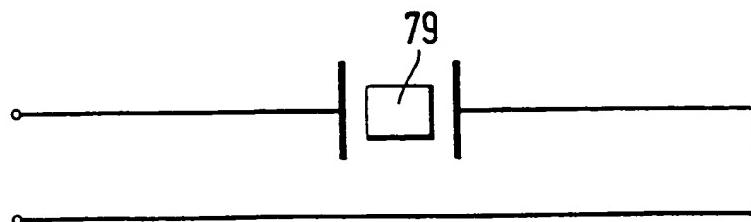


Fig. 59d

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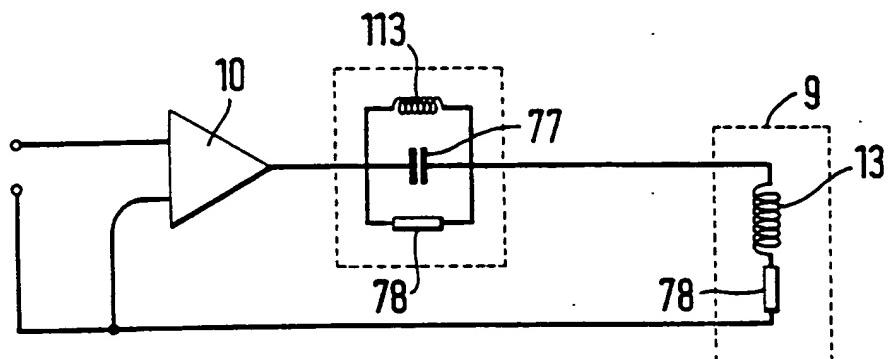


Fig. 60a

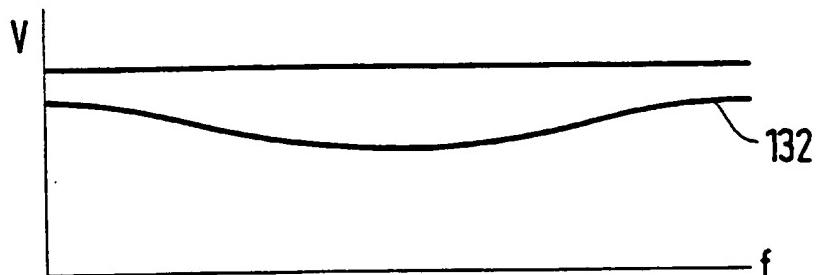


Fig. 60b

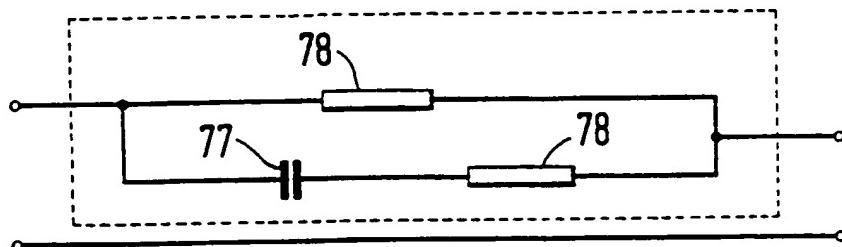


Fig. 60c

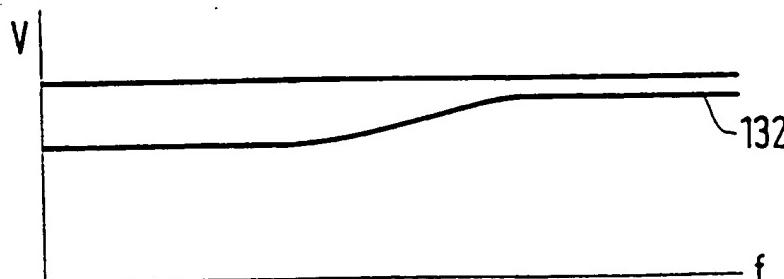
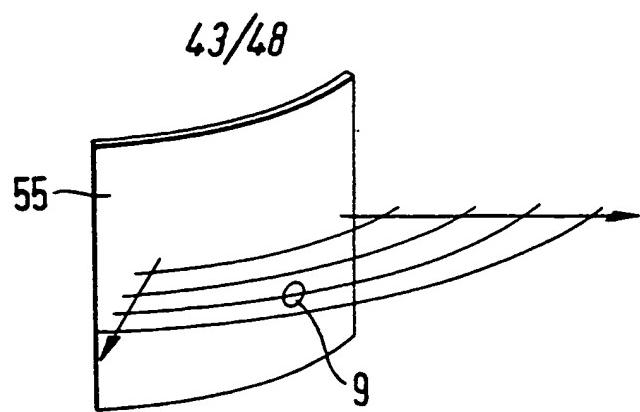
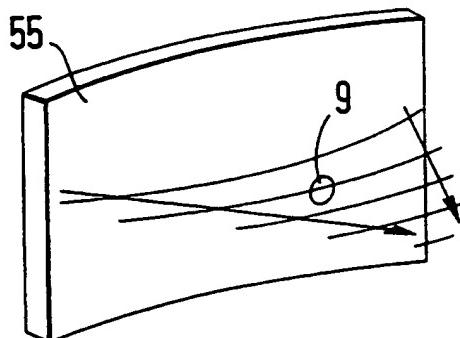


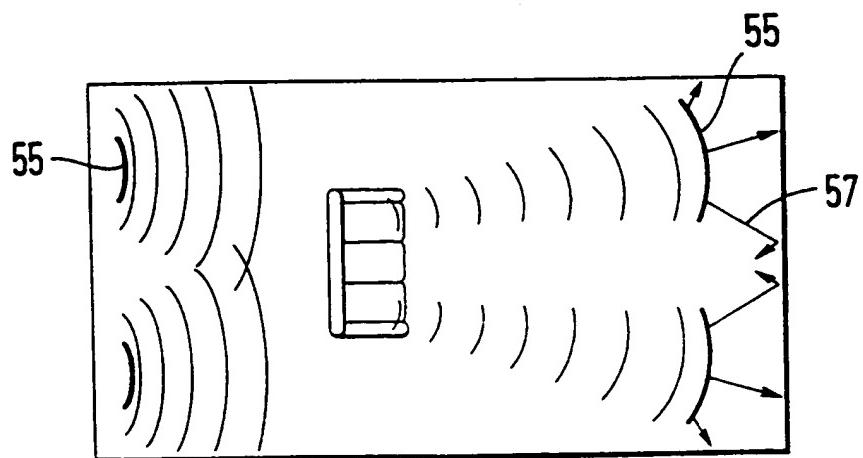
Fig. 60d



*Fig. 61a*



*Fig. 61b*



*Fig. 61c*

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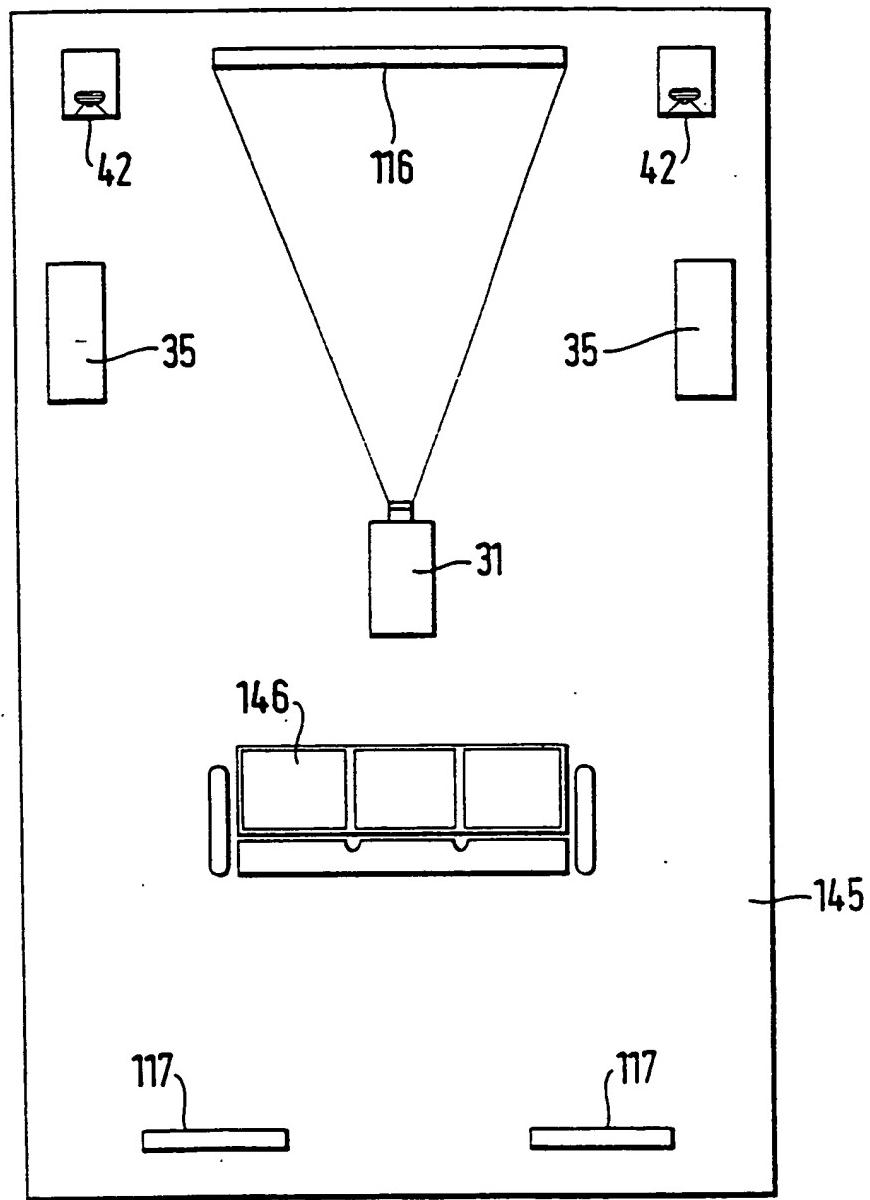


Fig. 62

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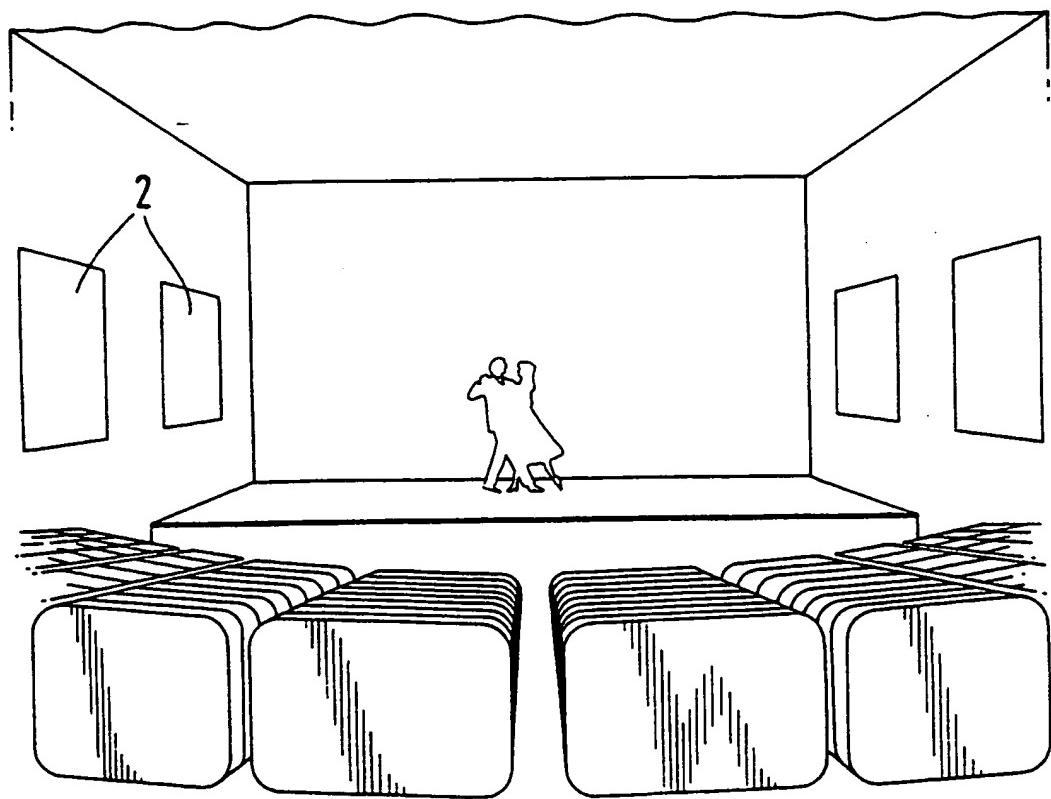


Fig.63

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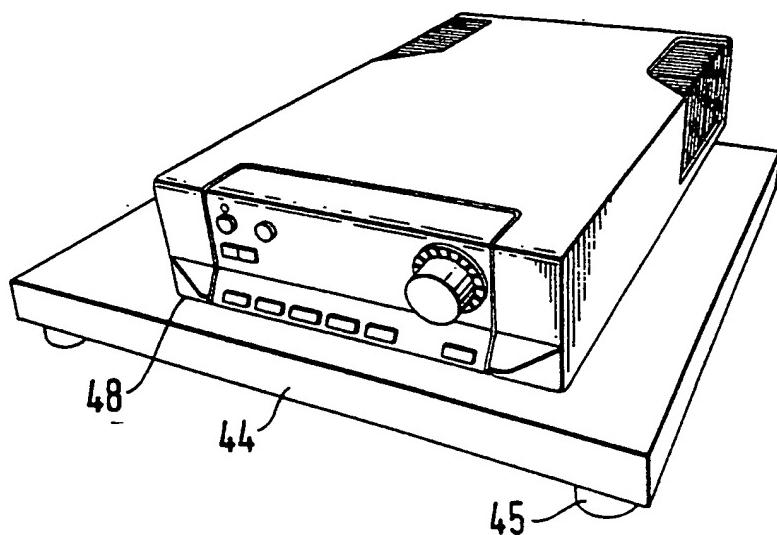


Fig. 64

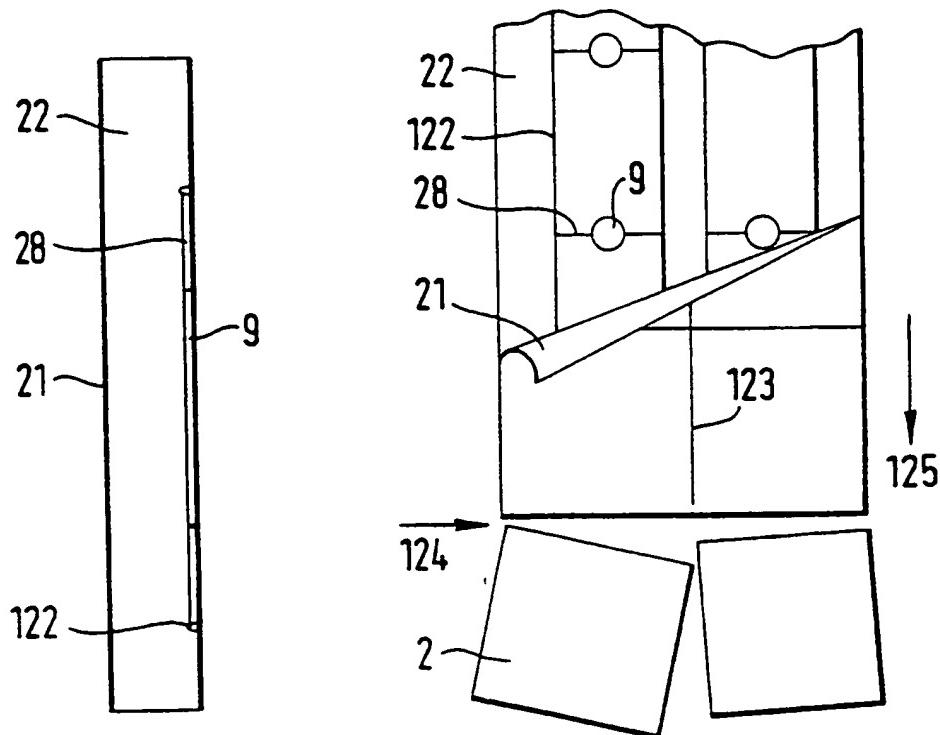


Fig. 67a

Fig. 67b

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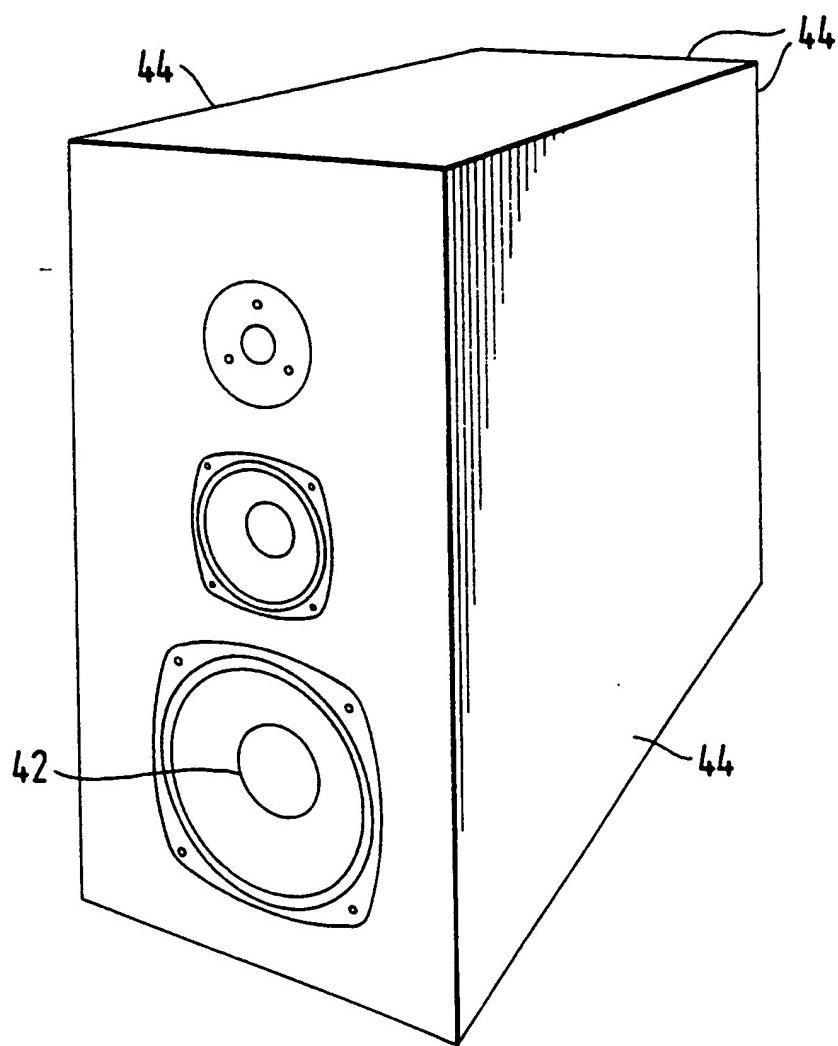


Fig. 65

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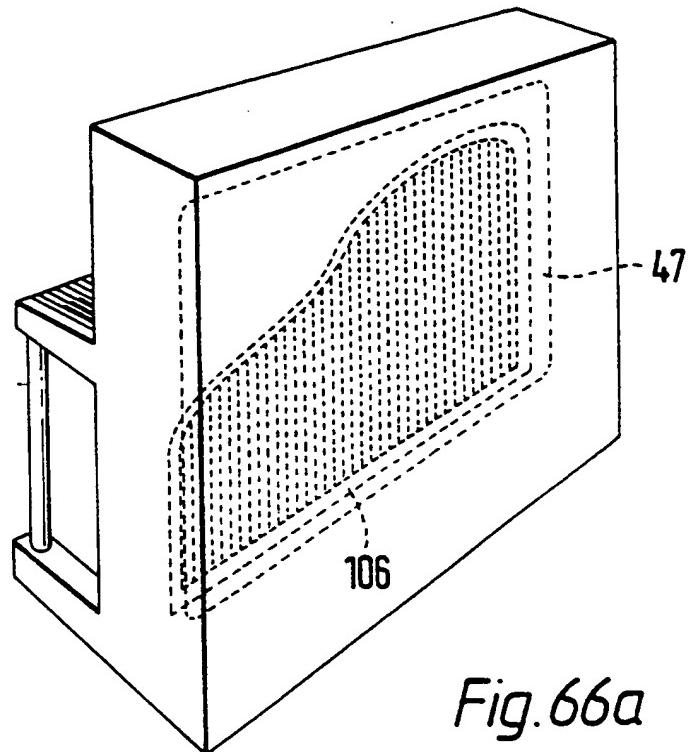


Fig. 66a

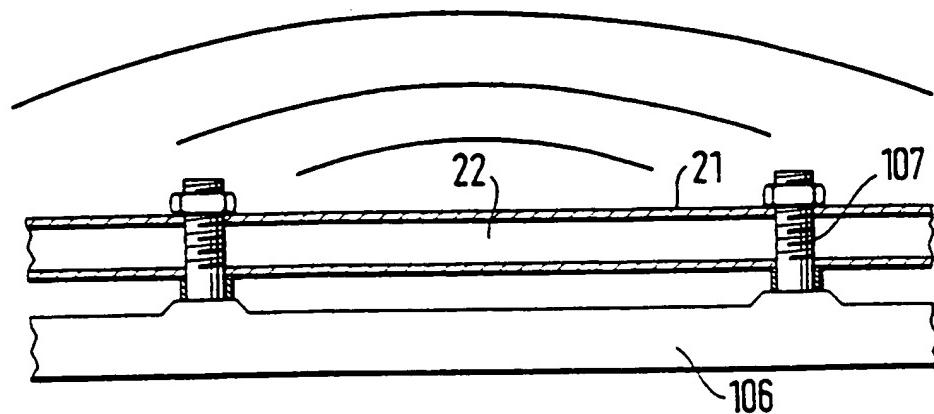


Fig. 66b